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Electrical World

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April 14, 1923

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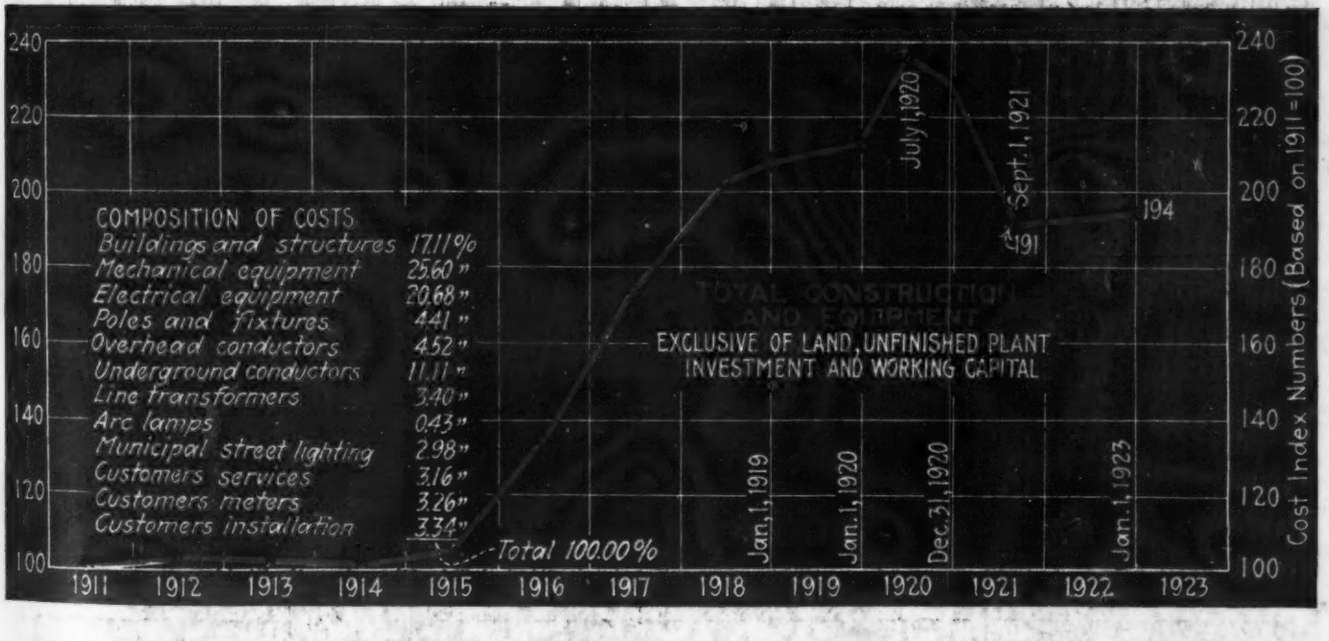
Trend of Construction Costs

By W. W. Handy

Cost is an all-important if not the determining factor in most construction programs. The variation of the many elements which enter into the composite curve here shown is strikingly portrayed by sixteen other charts of curves and the explanatory comments in the article by Mr. Handy.



Also in this issue:

Demand Meter Maintenance, by E. A. Le Fever

The Home Office Visits the Local Plant, by W. R. Voorhis

A Complete Million-Volt Transformer—II, by J. F. Peters and D. F. Miner

The Most Economical Power Factor in Industrial Plants

Connecting Services in Two Hours and Forty-eight Minutes

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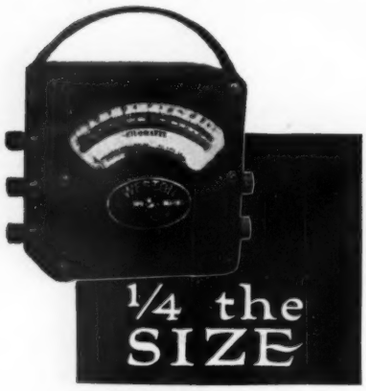
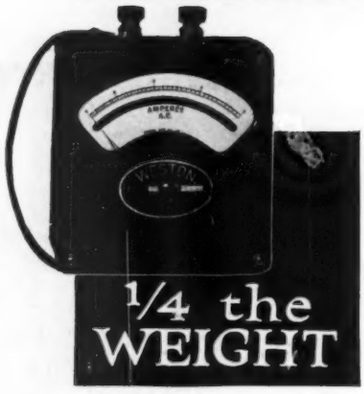
Reviews of Recent Books

The ANSWER to Your Testing Problems





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W. H. ONKEN, JR. Editor

HAROLD V. BOZELL Editor

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Loyalty Must Be Mutual

IN A CERTAIN city is a central-station operating organization headed by an executive whose vision extends far beyond the balance sheet and into the hearts and feelings of his fellow-workers. The activities of the "family" are led by an employees' club in which all employees meet on a common ground. It is managed solely by employees. Except for the times when he is called on to introduce a speaker in the periodical meetings or take some part that reveals his position, a casual stranger would find it impossible to pick "the boss" out of the happy, jolly crowd that gathers several hundred strong. Down through the entire force is a feeling of loyalty, a sense that "we are doing the job" developed to an unusual degree, which is clearly reflected in company relations with the community. The club work is simply a sign of the spirit that prevails from "the boss" down.

In another organization is a temporary utility construction crew, gathered together, as such organizations are, from casual labor available in the territory. With a record of 2 per cent a month in labor turnover, the entire working crew is found pulling enthusiastically to get the job done at the least cost, the various camp crews vying with each other in doing their best. A crew that meets with misfortune and falls behind is the subject of good-natured "ragging" that leads it to redouble its efforts to regain the lost ground. Every man knows how the job is progressing, knows what it is costing, and is taking a keen interest. Despite the higher wages, work is being done at a unit labor cost that is far under pre-war costs and in some cases almost unbelievably low.

WHY such results? Because in each case a man with real vision and the keenest of human sympathy is in charge. His forces are working with and not for him. Regardless of the disagreeable things that must be faced, the organizations know that "the boss" is looking out for their interests just as much as for those of the stockholders, and they also realize that he knows the value of the investment in the human material that makes up the organization and is as loyal to the men as he expects them to be to him.

The results in dollars and cents on the balance sheet in each case are results that no hard-boiled dollar-chasing policy can possibly achieve. The secret lies in the sturdy honesty, character, good sense and the broad human sympathy of the man at the top. His courage in acting in accord with these qualities is one of the fundamental reasons for a success that needs emulation in far too many organizations.

Frank William Peek, Jr.

A brilliant research engineer and formulator of the basic laws of corona.

THE electrical industry has been singularly fortunate in solving the technical problems that it has encountered in its progress and development. When progress is blocked by a technical obstacle there always come to the rescue the technical and research engineers who have been active in developing the industry along sound scientific lines. No industry in history has so closely followed a theoretical and technical program of development.

Frank William Peek, Jr., is a fine example of the modern technical engineer. His enthusiastic and rigid researches in the field of transmission and dielectric phenomena are typical of those of a band of engineers who devote their lives to research and invention. In 1910 Mr. Peek was engaged in the study of the problems of 250-kv. transmission. More than ten years in advance of commercial 220-kv. transmission, Mr. Peek built a high-voltage line, established and put in form for practical application the laws of corona, pointed out the necessity for grading line insulators and made other researches covering the control, protection and regulation of high-tension lines.

In the field of transients and dielectric phenomena Mr. Peek has created a position for himself second to none. His research papers on oil and air dielectric phenomena, transients, corona, insulation and lightning protection are studied and admired by all engineers and have been translated into foreign languages. His book on "Dielectric Phenomena in High-Voltage Engineering" is a standard reference and text book in technical schools.

Mr. Peek is a native of California and was born in Mokelumne Hill, Aug. 20, 1884. He is a graduate of Leland Stanford, Jr., University of the year 1905 and received his master's degree from Union in 1911. He became connected with the General Electric Company in 1905 and took the test course and then spent two years in the power and mining department. In 1909, upon its formation, he joined the staff of the consulting engineering department.

The A. I. E. E. has always been cordially supported by Mr. Peek, who has been chairman of its electrophysics committee for several years and is besides a member of other committees. He is also a member of the American Physical Society and other bodies. His calm judgment and winning personality have resulted in a host of friends who predict for him a still more brilliant future in his researches for developing the art of transmission.

Editorial Comment

Electrical World, April 14, 1923

Volume 81 Number 15

A Pregnant Source of Public Good Will

NEW sources or methods of contact with the public are always attractive to the industry, but good ideas are unfortunately somewhat rare. One such idea is embodied in a book issued last fall by the Smithsonian Institution—a work of art which possesses large possibilities in the education of the rising generation to an appreciation of the tasks and problems of the electric light and power industry. Much of the misunderstanding between the public and industry in general is due to ignorance of the functionings of industry, and not to any inherent enmity between the two. One cure lies in the proper instruction of grammar-school and high-school students in the operations of the various industries of the country, and this is exactly what this Smithsonian Institution publication aims to do.

The book is an unusually elaborate diagrammatic and pictorial study of the natural resources of Pennsylvania, based on the latest government data and designed for use in the public schools of the Keystone State. Each industry of the state is thoroughly covered both in text and illustration. The generation, transmission and distribution of electrical energy are explained in a clear and concise manner, the text being augmented by maps and a pictorial diagram of a complete generating and distributing system. Every advanced student in the State of Pennsylvania will study this book, and none can help being impressed by the intricate functionings of the electric light and power industry. Such instruction should make the pupil a better citizen as well as more sympathetic with the problems of the local distributing company. "Where there is no vision the people perish."

Pennsylvania is to be congratulated on this decided advance in public school instruction, and the central stations of that state will profit materially because of it. The Smithsonian Institution is desirous of doing the same work for the other states of the Union, and the state electrical associations would do well to help make this wish an actuality.

The Farmer Not a Radical

THAT the Middle Western farmer has turned from radical ideas acquired temporarily as a result of his severe post-war deflation troubles is the conclusion of competent observers. This has a direct meaning for utility men. Under the stress of deflation conditions the farmer as a political force struck blindly at a great many things that were apparently causes of his troubles. The elections last fall, especially in the Middle West, put into office many irresponsibles who may be expected to espouse all sorts of radical regulation or municipal ownership proposals. But the swing of the farmer back to his normal conservative mental state is already being made evident in the withdrawal of support of radical proposals made by these men who were put into office by the agricultural vote.

Utility interests faced by radical movements while legislatures were in session in the Middle West found it good policy to steer a clear course that would keep the conservative elements of the agricultural group with them. For the sake of their public relations, utility men need to avoid being stampeded by some unbalanced radical who breaks loose with wild proposals. It is worth while to keep close to the sober thinking people of the community and retain their confidence.

Equipment Betterments and the Executive

EXECUTIVE approval is necessary in such a large proportion of engineering betterment undertakings that it behooves operating men to make a special study of how to present such propositions to their superiors. Many a desirable improvement in plant has been flatly refused because of inadequate data, insufficient explanation or too confident an assumption that once the estimated economic justification was shown to the men "higher up" a favorable decision would follow as a matter of course.

Industrial-plant motive-power superintendents, electrical engineers and other technical staff members may be satisfied in their own minds that it will pay rich returns to install new equipment in particular cases, but such convictions are often inadequate to carry the appropriation to victory. Thus the proposal may arise to equip thirty industrial electric trucks with ampere-hour meters or to install watt-hour meters in factory departments and sub-departments. The busy executive listens to the proposal and multiplies the cost per truck or per meter by the total number involved—result, a sum perhaps not large in itself, but one that looks to the hard-headed executive like a target worth demolishing. He advances the opinion that the money had better be saved or expended in some other way, and the cause is lost for the time being unless the technical staff can summon reserves enough to break the line of opposition.

These reserves include specific information upon equipment performance under present conditions, reduced when possible to unit figures; a willingness to take a slice of bread when even half a loaf cannot be had, via the route of making piecemeal installations of economical devices; concise knowledge of results of using similar equipment elsewhere, adequate service record provisions, and an intimate understanding of the viewpoint and mental habits of the court of appeal.

Nothing can take the place of detailed knowledge on the part of the electrical engineer or motive-power man of the reasons why this or that piece of apparatus accumulated a good or bad reputation for service in the plant cost-accounting system. Maintenance costs on a particular truck, for instance, may be extraordinarily low during a certain period and catch the

executive eye. Incorrect deductions may result unless the reason be made clear; for example, that the equipment was held for painting and was out of service during a certain time. The present lack in many industrial plants of anything like adequate record systems of equipment performance badly hampers the engineer who attempts to convince his constitutionally and professionally skeptical superior that savings will be effected by the introduction of betterments. The older the plant, the more fertile should be the field for economic achievements by these means, and even in new plants it is sound policy to keep the door ajar when improvements come a-knocking.

Facts Concerning Electric Trucks Too Long Ignored

IN A RECENT address before the New York Electrical League R. C. Boyer pointed to some interesting figures of the New York Port Authority. According to these, 25 per cent of the trucks in New York are gasoline-driven, 2 per cent are electric and 73 per cent are still horse-drawn! The gasoline trucks are for the most part probably well fitted to the longer hauls—the wise man will not knowingly spend 6 cents per minute for a gasoline truck to stand or crawl in New York's slow-moving traffic on short-haul work. But in replacement of the 73 per cent of horse-drawn vehicles the electric truck should find an opportunity. Similar, though probably not so striking, conditions exist in other cities.

That the truck manufacturers are commencing to appreciate the situation is shown by the noticeable intensifying of their advertising (and, by the way, their factories have been much busier in the past two months). They have employed much newspaper space to point out that of every dollar received from sales of merchandise from 18 to 25 cents is spent for delivery by gasoline or horse; for laundry deliveries, 20 to 30 cents; for bakery goods, 18 to 25 cents; for ice cream, 20 to 30 cents, and for milk, 25 cents. Electric trucks, they say, can handle city deliveries faster than the gasoline car in city traffic, with the inherently easier starting, and they operate at a cost 20 to 35 per cent less and last longer.

These facts are worth pondering over a bit. Apparently too few central-station executives have ever really stopped to study them and picture what they might mean in dollars saved in the delivery of goods in their own cities. An opportunity to cut delivery costs 20 to 35 per cent where at present the expense runs 18 to 30 cents on every dollar taken in is something on which no man who has goods to deliver will turn his back. The trouble has been that he has not known that the electric truck could do so much for him. The central-station man has not known it either. They have both been told, but neither has paid attention and realized what the figures mean.

But here are facts that demand recognition. The electric truck is shown to offer a fundamental economy in a large field of urban distribution. There is a demand, if not a clamor, for reduced distribution costs in cities, and conditions could hardly be more favorable than they are right now for instilling the idea of electric trucks for city deliveries. The first step everywhere is for the central-station man to learn and believe these facts. Then let him go to work with the truck manufacturer to demonstrate them to every man in his town who uses trucks and to see that servicing facilities are established. From this will some day grow the substantial vehicle load that all men know will ultimately come, to the real profit of the electrical industry.

Handling Service Applications Promptly

RECENT observation of the time lag between a number of applications for central-station service and the introduction of energy into the new customers' establishments raises the query whether utilities of this class are doing all that they can do to expedite such procedure. The larger the company, the more of a problem it becomes to avoid delays in furnishing service, and frequently these delays are due to conditions outside company control. None the less when complaints that there is a gap between promise and performance become frequent it is time to look sharply into the cause.

What the Syracuse Lighting Company has accomplished in reducing the elapsed time between the signing of the application for service and the execution of the order to less than three hours is a fine example of what can be done to cut red tape and eliminate lost motion. At no increase in cost over the former method, the company is rendering a high grade of service that has produced the most tangible of results in making friends of its customers. The methods employed by the Syracuse company merit serious consideration by every central-station man who is interested in winning the good will of the public.

The whole subject of furnishing service and its routine is a large one. It is out of the question to suggest in a few paragraphs detailed solutions of a problem which has interested central-station managers for decades, and yet the need of applying efficiency engineering to this branch of company business is far from imaginary. Viewing the matter broadly, the public policy of providing service to applicants is the most important phase of the question. There have lately been some very discouraging reports on service delays after approved applications have been set in motion departmentally. Promises to give service by particular dates have not been kept; agreements as to installation costs of reaching residences from street mains have been too informal, sometimes on mere scraps of paper, and in some cases the calling of official attention to unwarranted delays in putting service into operation has had scant result. In other cases certain standardized average costs of reaching the consumer have been applied, with the result that the consumer has gone ahead and done the work himself at lower outlay and with a correspondingly poor opinion of the utility's regulations and charges.

In countless thousands of cases central-station companies are doing all that is possible to render prompt service to applicants, and in many other instances good reasons can be adduced for apparent failure to furnish service on expected dates. To call attention to the fact that too many cases have come to the front of late where popular good will has been jeopardized through delays in the installation of service is but to urge that utility executives check up their practices in this respect and ascertain whether departmental red tape is not here and there strangling accomplishment and hampering the development of friendship with new customers. A

policy of indifference in this matter is a dangerous game to play, for the public is going to have the service it demands, and if company managements do not meet the need, this branch of public relations will be taken out of their hands.

Boiler-Room Practice of Tomorrow

WHEN the development and perfection of a type of equipment or system of operation becomes complete, the electrical industry is particularly addicted to finding another type of equipment or system of operation that promises better performance or is better adapted to its needs. When the steam engine reached a remarkable state of perfection the turbine came into being; when the direct-current system became satisfactory the alternating-current system was developed into a commercial possibility. In each case the replacement of the old by the new worked out to the ultimate advantage of the industry.

Are we now witnessing the same kind of revolutionary changes in boiler-room practice? Recurrent news of pulverized-fuel stations, thousand-pound boiler pressures, separately fired superheaters, preheaters, new designs of feed-water systems and operation at temperatures over 700 degrees cannot fail to impress central-station engineers and executives. Such changes are radical and yet they seem to develop overnight from theoretical dreams into practical installations. The light and power industry is especially daring in its engineering work because the prize to be obtained through increased efficiency in operation is so great. On the larger systems a gain of even 1 per cent in efficiency can be capitalized for a substantial sum, and every inducement is offered for trying out new equipment and practices which promise better and more economical service. Yet the widespread adoption of pulverized fuel, high pressures and high temperatures for the new power stations, although based broadly on sound engineering, affords food for thought and presents opportunity for many complications.

No question exists as to the splendid efficiency and better adaptability of boilers fired by pulverized fuel, but some pretty weighty problems are still to be solved before standard or satisfactory practice is to be attained. In the very large boilers contemplated the stack effect of the long flame, the effect of the high temperature on refractories and tubes, the proper baffling to insure most efficient heat absorption and many details of fuel handling, crushing and firing are difficult to determine by paper design. Yet the development of the practice has proceeded to such an extent that courageous engineers do not falter in the face of these comparatively minor details but render their decision on the basis of the big possibilities for more economical and convenient operation. There is no reason to doubt that the minor troubles which occur will be solved by the engineers.

Operation at high temperature is accompanied inherently by more difficult problems. It reduces to a question of materials and in its theoretical aspects invades the realm of metallurgy. Valves, valve stems, pipe and pipe fittings to operate at 800 degrees or even higher have yet to be developed, and indications point to an extensive use of alloys or very high-grade steel. Much experimenting and research must be done on materials and much better design will be necessary to secure successful operation. Even the turbine must be redesigned and perhaps rebuilt to operate under the contemplated pressures and temperatures.

Yet these radical changes in boiler-room practice have advanced to a stage where nearly 750,000 kva. in new station capacity is being installed along lines embodying the new features. The next two years will see station after station starting operations using powdered fuel, high pressures and high temperatures. Never was there a greater degree of combination and readjustment in boiler-room practice or more opportunity for initiative and sound engineering. Such moves make the light and power industry advance still more rapidly on its conquering career.

Opportunity to Increase Switch Ratings by Minor Modifications

THOUGH no very definite information has been released by electrical manufacturers who have co-operated with operating companies in the testing of old and standard-type circuit breakers during the last few years, the statement is generally gaining credence that the rupturing capacity of some of the old circuit breakers can be increased considerably by relatively simple modifications and without great expense. This does not mean that any operating company can expect to handle greatly increased short-circuit currents merely by modifying old circuit breakers. It does mean that if the rupturing duties have not increased very much, the switches can possibly be strengthened by consulting the manufacturer and purchasing replacement parts. In cases where even the modified breakers will not be adequate for increased short-circuit duty in their existing positions they may be moved to positions of less severe duty and can be expected to perform better than the unmodified breakers.

In general the changes involve one or several of the following modifications: Increasing head of oil over the contacts; provision of explosion chambers; installation of combined gas vents and oil-separating chambers; stronger tank covers and tie rods, and improved contacts. No one switch is likely to require all of the foregoing modifications. In some cases round tanks are preferred to other shapes, static shields must be removed from terminals, contact terminals must be braced, or stuffing boxes must be provided around the operating rod.

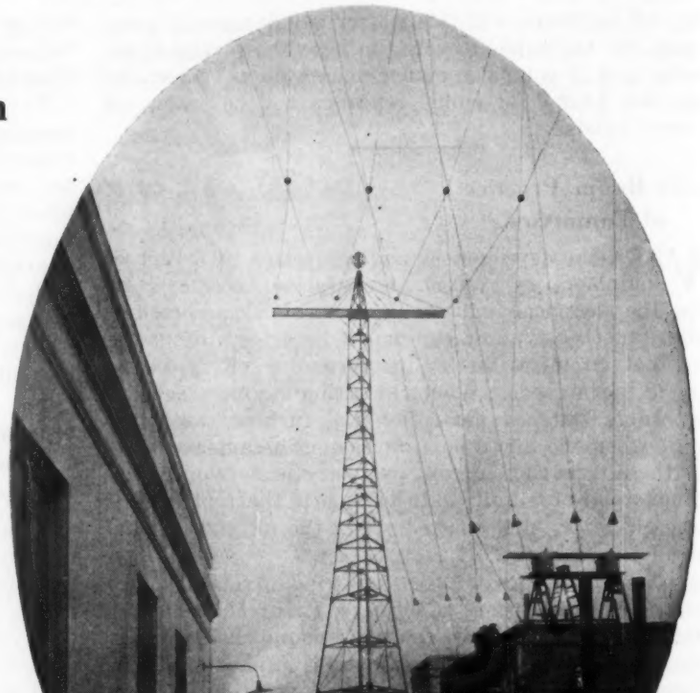
Some companies are going ahead with modifications of the character outlined, utilizing the old equipment almost entirely but adapting it to the replacement parts. Where greater oil heads are required, an extension is being welded on the top of the tank and new insulating linings are being inserted.

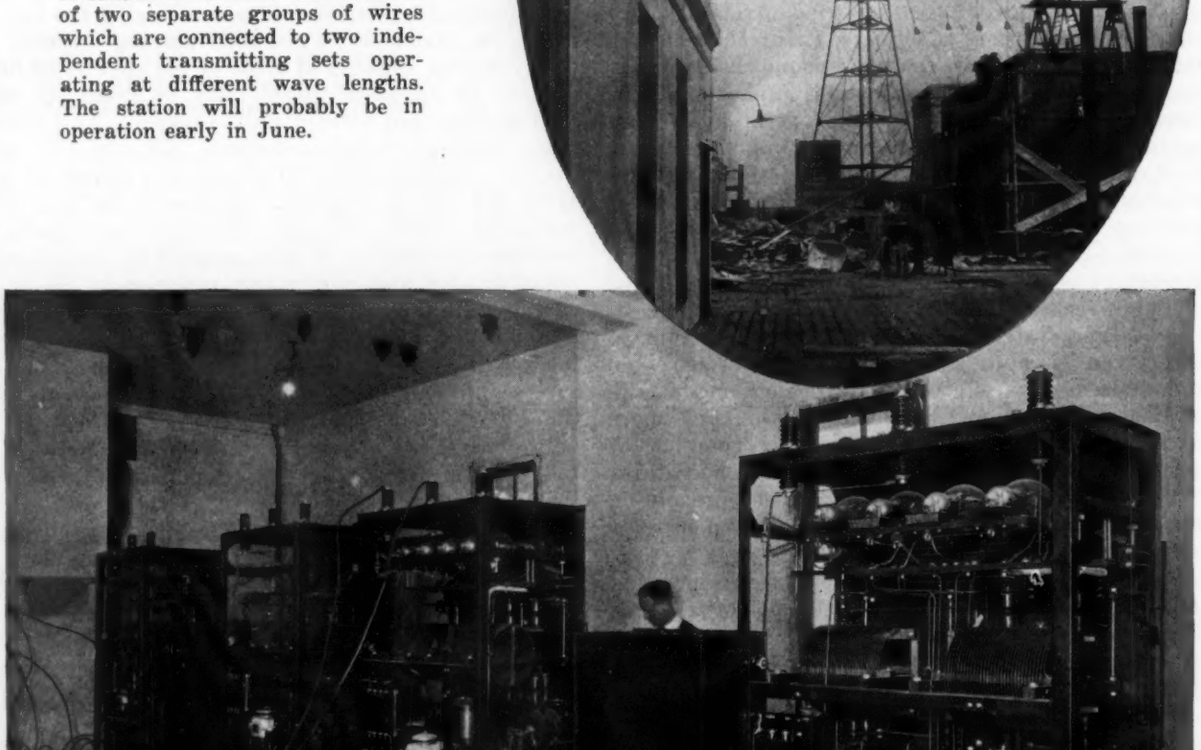
According to the co-operative tests conducted on the modified breakers the expense of making the changes is fully justified by the improved performance of the breakers and the resulting increase in service reliability.

To a limited extent manufacturers are now carrying on this modification for customers where a situation is really pressing. But most manufacturers are heavily loaded with orders for equipment sorely needed for extensions and it would not be to the general interest to add to their burdens unnecessarily. Where immediate relief is urgently needed with existing equipment, users are advised to consult the manufacturers who made the particular switches in question for details as to what to do.

New Broadcasting System to Transmit Two Programs Simultaneously

ANTENNAS and broadcasting equipment capable of transmitting two different programs simultaneously are being installed on the Aeolian Building, New York City, by the Radio Corporation of America. The antenna consists of two separate groups of wires which are connected to two independent transmitting sets operating at different wave lengths. The station will probably be in operation early in June.





Complete Million-Volt Laboratory—Part II

Auxiliary Equipment Consists of a Sphere Gap, Crest Voltmeter and Control Transformers and Resistors—An Adequate Oil System Is Necessary—Specially Designed Rectifier Is Used

By J. F. PETERS and D. F. MINER
Engineering Department, Westinghouse Electric & Manufacturing Company

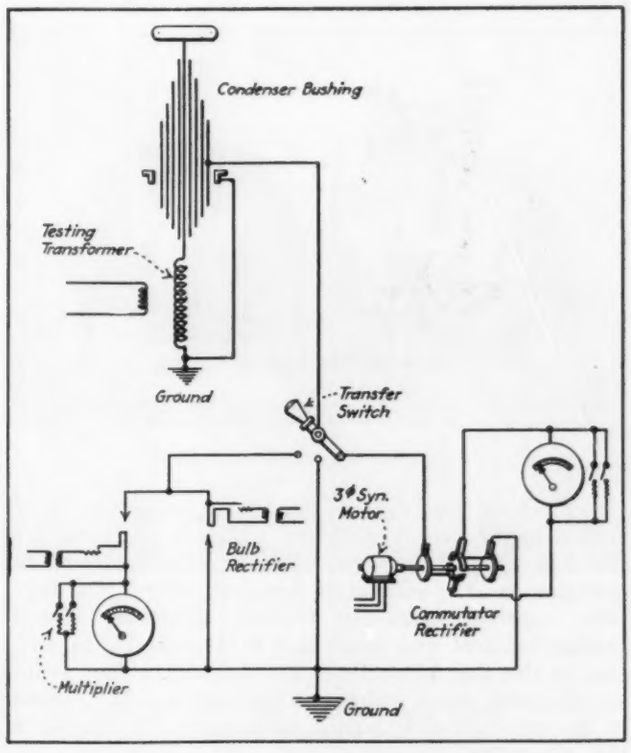
IN ADDITION to the transformer equipment for supplying high voltage, a complete laboratory must have auxiliary apparatus for control and measurement purposes. This equipment is usually specially designed and must be very reliable and accurate as its functioning is absolutely essential to securing correct data. One of the most important high-voltage devices is the sphere gap, and the 100-cm. gap is one of the assets of the laboratory.

Following the pioneer investigations of Fortescue and Farnsworth of the Westinghouse company in 1913, the sphere spark gap was adopted by the American Institute of Electrical Engineers as a secondary standard of high-voltage measurement. An air gap between two metal spheres breaks down and allows a spark to pass at a surprisingly uniform voltage. A definite relation, only slightly affected by atmosphere changes, exists between the size of spheres, separation and voltage necessary to start an arc. No other form of spark gap can be relied upon to such a degree of accuracy. Meters used for indicating high voltages must be standardized by comparison to a sphere gap. In order to insure greatest reliability the sphere gap should not be used at separations greater than the sphere diameter. This limits the accurate range of any diameter of spheres and necessitates the use of several sizes of sphere gaps, each suitable for a limited voltage range. When the million-volt transformer equipment was designed no existing sphere gap was suitable for measurement of such potentials. Consequently a 100-cm. sphere gap was included in the plans.

Each ball was cast of special bronze and carefully turned to 100 cm. diameter (39.37 in.). After turning, micrometer measurements of several diameters were made daily for a long period and slight changes were found to occur, due to release of internal strains. When these movements had ceased the spheres were trimmed in the machine to insure perfect spherical shape. When finished each ball weighed 400 lb., with a wall $\frac{3}{8}$ in. thick.

In mounting this gap one sphere was placed on the end of a micarta tube attached to the top of the condenser-bushing static shield. The other was suspended vertically over it on an insulating shaft terminating in a metal rack. A motor operated from the switch room is geared to this rack and raises or lowers the upper sphere at the will of the operator. A counter weight is provided to balance the sphere, so that the motor can control the movement sensitively. The separation of the spheres is read on a vertical scale with a pointer attached, through multiplying pulleys, to the upper end of the sphere shaft. Zero setting is accomplished electrically. When the upper sphere is run down until it touches the lower sphere enough to change the downward pull on the shaft, an automatic device operates a limit switch, stopping and braking the motor instantly.

A resistance rack is installed to limit the gap discharge to full-load current (1 amp.). This consists of a group of carbon rods mounted on an insulating frame hung from the roof truss and connected at one end to the upper sphere and at the other to ground. The spark then jumps the gap, travels to the resistances, thence to ground. Above the upper sphere a grounded metal surface was built to preserve a uniform field.

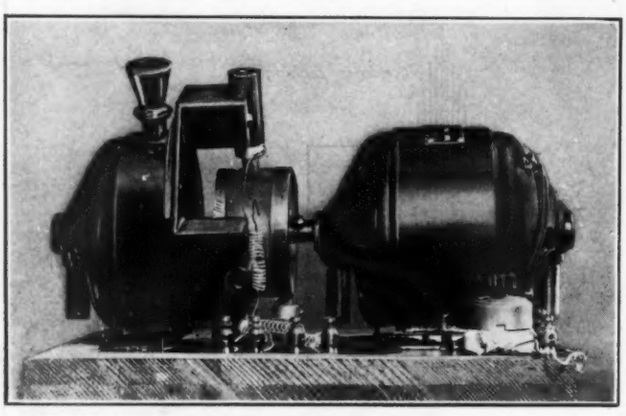


CONNECTIONS FOR CREST VOLTMETER

Starting with the incoming lines at 22,000 volts, power is controlled by an electrically operated automatic circuit breaker in the substation and connected to a 1,000-kva. tapped supply transformer. From this point there are two systems by which the voltage supply to the million-volt transformer may be controlled. With good conditions on the power line a 35-kva. step-induction regulator is used, directly connected by a remote-control circuit breaker between the taps of the supply transformer and the primary of the testing transformer. This regulator consists of a motor-operated induction regulator provided with a drum above with connections to the transformer taps. The regulator raises or lowers voltage between taps, and when the limit is reached connections are automatically switched to the next set of tap connections. By this arrangement a very uniform and consistent rise of primary voltage from zero to 5,000 volts is obtained.

For accurate testing, or when circuit disturbances are present in the main supply, a motor-generator set is used. This is connected through circuit breakers to the supply transformer secondary, using this winding as an auto-transformer to supply the induction regulator, with the primary (22,000-volt side) disconnected. Generator field control, motor-operated, may also be used if desired. The generator is a special 600-kva. unit, 5,000 volts, single-phase, 60 cycles, designed for good wave form at low power factor. It is directly connected to an 800-hp., 2,200-volt, three-phase, 900-r.p.m. synchronous motor, driven from the central-station supply. A 23-kw., 250-volt exciter is also provided.

A grid resistance insulated for 5,000 volts is arranged to be shunted across the circuit breaker which connects the regulator to the supply transformer. This is used for sustained flashovers. After breakdown has occurred this circuit breaker is opened automatically and the resistance inserted, cutting down the primary voltage and limiting the current. The circuit is finally cleared when desired by tripping the substation breaker.



VIEW OF COMMUTATOR RECTIFIER

Control of the various auxiliary apparatus is installed in the operating booth, which is so placed that the test floor is in view. Within easy reach of the operator are the substation breaker control, the regulator control, spark-gap control, generator circuit-breaker control and generator field control. In addition to the manual switches and buttons, a foot switch was installed upon which the operator stands. Release of pressure on this button disconnects the power at the substation.

CREST VOLTMETER USED TO MEASURE VOLTAGES

It is essential that the greatest possible accuracy be obtained in indications of voltage on testing transformers. Experimental data are frequently relied upon to furnish information for design of a complete line of equipment. If the test results are in error, disastrous failures may occur and expensive changes become necessary. As the test voltages employed have risen in advance of commercial practice in the last few years, the importance of reliable high-potential measurements has brought improvements of interest.

As a measuring instrument the sphere gap has some disadvantages. It is not an indicating instrument but a limit measure. Measuring voltage by a spark gap is like measuring steam pressure with a nicely adjusted safety valve. Whenever a reading of changing voltages is desired, or if it is required that a certain test voltage be applied to some apparatus, another form of instrument calibrated by comparison with the sphere gap must be used.

For relatively low voltages (up to 50,000) a voltmeter reading the primary voltage of the transformer may be relied upon to indicate the secondary or high voltage, using a multiplying factor of the ratio of secondary to primary turns. If the transformer is well designed, with closely coupled windings and low leakage reactance, this method is sufficiently accurate for all testing purposes.

Above 50,000 volts two factors enter to destroy the accuracy of the turns-ratio method. First, insulation requirements involve greater spacing between primary and secondary coils and thus greater distance of secondary from the core. The entire magnetic flux then does not link all coils, and the primary voltage necessary to establish the leakage flux in addition to the useful flux does not bear a true ratio to secondary voltage. Furthermore, the error is not constant but increases with voltage. The second factor is that of capacity reactance. In transformers built for the higher test voltages (300,000 and upward) the construction is often such that there is considerable capacitance between coils and between coils and case. In the million-volt transformer and several 500,000-volt units recently constructed by the Westinghouse Electric & Manufacturing Company a new design was used, employing nested concentric tubes with single-layer coils wound on them. The construction resembles the form of a condenser bushing. This gives a very high capacitance, which is of value in distributing internal stresses between windings. However, it also produces a secondary voltage higher than the turns ratio would warrant. In other words, it has a positive regulation which increases up to about 25 per cent at full voltage. The million-volt transformer primary is designed for 5,000 volts, or a 200 to 1 ratio, but application of slightly more than 4,000 volts will produce a million volts on the secondary, a ratio of 250 to 1.

Two methods of indicating voltage in the case of extremely high-voltage testing transformers are in use. One is by what is called a voltmeter coil. A specially designed and placed small coil is built into the transformer and corrected for errors by compensation. The voltmeter then reads the secondary voltage quite well under proper conditions. It will read effective value, however, no matter what the wave shape. Distorted wave shape may be present owing to source of supply or to character of the load.

In most testing work we are interested not in the effective value of the wave but in the peak. The highest voltage reached during the cycle is the value to which the apparatus is subjected and which will cause failure. For this reason the sphere spark gap is an excellent standard. It is, in effect, a standard piece of insulation (an air path in a uniform electrostatic field) which will fail in a manner similar to the apparatus to be tested, and its breakdown is determined by the crest value. Usually the calibration curve of a sphere gap is, however, marked in values of the equivalent sine wave effective voltage ($E_{max.}/1.41$).

The other method is the crest voltmeter, developed by L. W. Chubb of the Westinghouse company. It can be demonstrated mathematically and experimentally that the average value of the charging current to an electrostatic condenser is proportional to the peak of the applied voltage wave. An average-value reading instrument and a condenser connected to the voltage to be

measured are therefore needed. The charging current to the condenser bushing of the transformer is rectified and passed through a D'Arsonval type of direct-current meter, connected at the ground potential end. The meter can be calibrated directly with uniform scale in secondary volts or kilovolts.

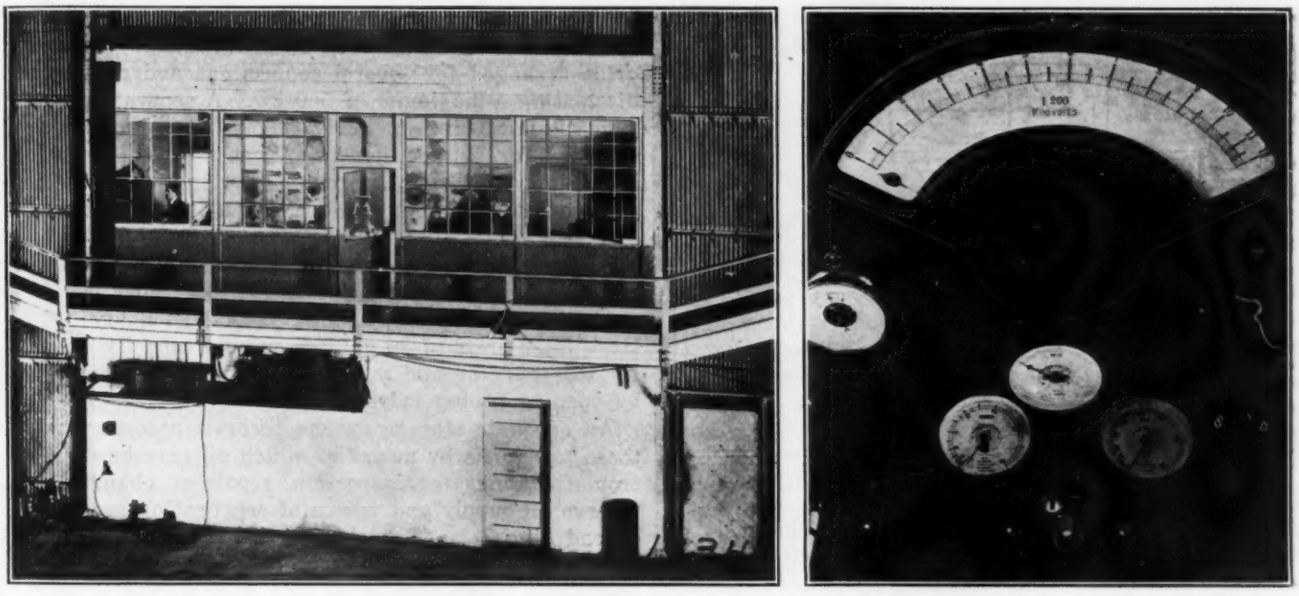
For several years the rectifiers used in crest voltmeters have been of the bulb type, using a hot cathode in a mercury vapor. With such distortions of wave shape that the bushing charging current (differential of voltage wave) crosses zero more than twice per cycle, the bulb rectifiers are inaccurate, for they entirely suppress the negative loops instead of adding them algebraically. While harmonics do not usually occur in such values as to cause this excessive distortion, certain combinations of testing conditions have been experienced where this does occur, especially at the extremely high voltages in use.

To provide for such conditions an additional system of double mechanical rectification with separate meters was installed. The duplicate system has the added advantage of a spare in case of damage to either set of instruments or circuits. A ratio voltmeter is also available and can be calibrated against the crest voltmeter for approximate indications in case of failure of both other instruments. On the panel a convenient transfer switch is used to connect in the bulb rectifier system, the mechanical rectifier, or to short-circuit and ground all meters.

The mechanical rectifier was built by mounting a special commutator on an extension of the shaft of a three-phase, four-pole, ¼-hp. synchronous motor connected to the same supply as the transformer. The commutator consists of a brass cylinder mounted on an insulating core. Four brushes bear on this ring—two for the alternating current coming from the condenser bushing and two carrying the rectified current to the meter. The cylinder is so slotted that each meter brush is alternately connected to the two alternate-current brush segments, the reversal taking place at the zero point of the wave. A lever on the brush rigging allows the brushes to be shifted relative to the motor frame so that the point of maximum rectification can be found. After this adjustment is once made it rarely needs to be touched.

The indicating meters are made sensitive enough so that they are normally shunted when used for highest voltages. This permits the use of switches increasing by steps the resistance of the shunt for various ranges or cutting out the shunt altogether for low readings. This means of making a multi-range instrument is very flexible and may be modified to suit conditions. Usually two or three fixed ranges are sufficient. The scale of the larger of the two meters (used with mechanical rectification) is divided into twelve major divisions and 120 minor divisions. The best arrangement of shunts found for this million-volt set was full-scale reading of 1,200,000 volts and 600,000 volts, giving the easily used multiplying factors of 100,000 and 50,000. The smaller meter, used with the bulbs, contains 100 minor divisions and similar factors may be used.

The operator in his booth is usually occupied with several duties—control of the various switches and general observation of events out on the test floor. Consequently it is desirable to have the meter scales as long as possible and clearly marked so that readings may be accurately taken without loss of time or distraction of attention from other events. The meter elements must also be dead-beat, yet not overdamped, a requirement hard to meet when the needle is long and travels over quite a distance.



VIEW OF CONTROL ROOM, AUXILIARY EQUIPMENT AND CONTROL PANEL

This crest-voltmeter installation has proved to be entirely satisfactory as to accuracy and convenience, and the principle, devised long before the present high voltages were available, solves problems of more exacting requirements than were originally anticipated.

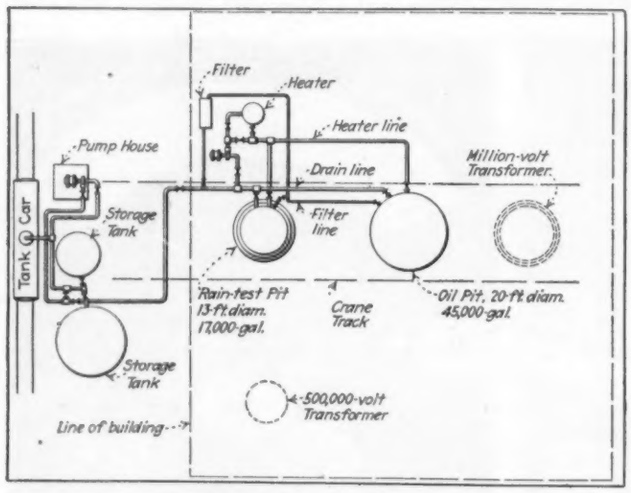
The second testing transformer is similar in construction and is equipped with auxiliaries similar to those of the million-volt transformer. The tank, provided with an internal barrier, is 9 ft. in diameter by 10½ ft. high. A similar cover with a projecting lip for shielding was used and nothing projects above the surface except the bushing. On top of the condenser bushing, which is 12½ ft. long and 21½ in. in diameter at the flange, rests the upper static shield 5 ft. in diameter and 10 in. thick. A reactance coil for protec-

tion is wound on a micarta tube attached to the top of this "hat" and terminates in a connector.

The capacities of the supply transformer (500 kva.), the generator equipment (300 kva.) and the testing transformer (500 kva.) are just one-half those of the corresponding equipment for the million-volt set. For uniformity in installation and repair the circuit breakers and regulator, however, were made identical with the larger outfit.

In the control room an operating booth for the 500,000-volt transformer was installed with similar switching control and metering arrangements, except that no spark-gap control was needed. In place of the stationary 100-cm. sphere gap a portable 50-cm. gap is used with this transformer. For lower-voltage tests a 25-cm. gap is available.

The two testing transformers may be used simultaneously for different work without interference if desired. With the two transformers on the same supply phase,



LAYOUT OF OIL PIPING SYSTEM

1,500,000 volts difference of potential is obtained between the two transformer terminals with ground potential one-third of the total from one side. Another connection useful with three-phase transmission-line work may be used. The transformers may be switched to different phases to obtain a phase angle of 120 deg. between the high potential windings.

Most of our stationary types of electrical apparatus—transformers, circuit breakers and electrolytic lightning arresters—use a petroleum-base oil for insulating purposes and as a medium for conducting internal heat from the electrical parts to the outside. In order to utilize these two valuable characteristics of transformer oil to best advantage, careful design studies must be conducted. The combination of solid insulating members with oil involves consideration of the relative specific inductive capacities, the internal losses and other factors. Furthermore, corona under oil may present serious problems, and research must be undertaken to determine the best forms of conducting members adjacent to insulation. The characteristics of solid insulation change with temperature, so that engineers must have data at oil temperatures similar to those reached under heavy load on apparatus. For these reasons extensive facilities have been provided for oil tests.

A steel tank, 20 ft. in diameter and 20 ft. deep, holding over 45,000 gal. of oil, was installed. Placed in this tank is a large wooden frame, 14 ft. x 14 ft. x 16 ft., with adjustable cross-members for supporting any apparatus or model under test. If desired, the frame may be raised from the tank and changes or adjustments made at a convenient location.

Another tank, 13 ft. in diameter and 18 ft. high, in a concrete pit, is used for bushing tests. The cover of this tank is fitted with flanged plates to accommodate various sizes. The lower end of the bushing is immersed in the oil, and the upper may be kept in dry air during test or a heavy spray may be directed against outdoor types. The water runs off the cover and is drained out of the concrete pit.

An extensive piping system is required to handle the large volume of oil (60,000 gal.) in these test tanks. When hot oil is desired in either or both, a centrifugal pump of 500 gal. per minute rating is started to circulate the oil through a heater. Cold oil is drawn from the bottom, passed through the heater and delivered to the top of the tank. The discharge pipe is built in sections, so that the hot oil may be delivered just below any desired oil level to prevent foaming. The heater tank, 5 ft. in diameter by 8 ft. in height, contains grids arranged for several connections and capable of dissipating a maximum of 500 kw. A separate substation circuit breaker and supply transformer are installed for this equipment. Even with this rate of heat supply to the oil, approximately ten hours is necessary to heat the oil in the larger tank from 10 deg. C. to 70 deg. C.

After continued use, especially at high temperatures, the oil deteriorates, but filtering will remove the impurities and moisture, making the oil good again. A large filter press of 30 gal. per minute capacity is used for this purpose and may be connected to either tank by opening proper valves.

An adequate storage system becomes necessary with these test tanks by means of which oil may be drained from the tanks for inspection, repair or changes. A reserve oil supply and means of segregating special oil or bad oil is also desirable at times. For these purposes two storage tanks were constructed outside the laboratory. They are so located, with necessary pump and piping, that new oil may be easily taken from a tank car on the railroad side. An unusually flexible piping arrangement in connection with the storage tanks allows the following operations: (a) Pumping oil from tank car to either or both test pits; (b) pumping oil from tank car to either storage tank; (c) pumping oil from either or both storage tanks to either or both test pits; (d) draining oil from either or both test pits to either or both storage tanks.

Both test tanks are provided with piping attached to a 500-gal. "Foamite" chemical engine. In case of fire the opening of a valve permits mixing of the chemicals and a blanketing of the oil surface with a foam which smothers the flame.

LAYOUT OF SUBSTATION AND GROUNDS

Power from the transmission system of the Duquesne Light Company is delivered to the laboratory at 22,000 volts, three-phase, 60 cycles. This power, through disconnecting switches and automatic circuit breakers, is supplied to the separate transformers installed for the larger power-consuming equipment. Each test transformer and the oil heater have separate supply units. The low voltage of the testing transformer supply units is arranged with several taps, with a maximum of 5,000

volts. The heater circuit is 2,200 volts. In addition, a three-phase, 1,000-kva. bank, 22,000 volts to 2,200 volts, is provided for auxiliaries, such as crane, lighting, motors, etc. The total connected load of the substation is 3,000 kva.

Adjacent to the laboratory, which is on a hill, there is over an acre of level ground intended for outdoor testing. Life tests and weathering studies are set up here and leads connected to the testing transformers through the 60-ft. x 45-ft. doors. There is unusual opportunity for transmission-line investigation in this location along a right of way through relatively unimproved property leading from the laboratory for over a mile. Beyond this another long stretch is available with only slight contact with civilization.

In high-voltage research photographic instruments for recording phenomena both visible and invisible to the eye are of great aid. The high-voltage laboratory has a complete portable oscillograph with accessories with which valuable data have already been obtained on testing-transformer transient characteristics. Recently great importance has been attached to high-speed photography for studying the progressive changes in insulator flashovers under various conditions. For this purpose a special high-speed camera, designed by the designer of the portable oscillograph,* J. W. Legg, has been provided.† This camera is capable of taking exposures at a rate up to 3,000 per second. Besides these instruments, a camera for ordinary photographic work is used. Dark-room facilities are provided in the control building.

*A. I. E. E. *Transactions*, July, 1920.
†*Electric Journal*, December, 1919.

The Home Office Visits the Local Plant

A Bit of Satire Pointing Out the Hurt and Harm that This Can Do, Whereas the Situation Offers a Great Opportunity

By WARREN R. VOORHIS
Vice-President American Water Works & Electric Company, New York City

IN THIS day of holding companies of large business interests and utilities, a semi-oversight and management of the various branches is usually maintained at what is known as "the Home Office." This necessitates the visit of officers, auditors and inspectors from time to time to the branch offices, and it is to these "visitations" that the following article applies.

He Sees the Plant

The doorway of the "local plant office" is darkened.

It is the representative of the home office.

He is about to visit the local plant.

The flustered cashier rejoices in the safety of his cage; the girl at the adding machine misses her decimal point; the typists pound furiously on the keys; the plant manager scrambles into his coat and puts his monthly report to the home office on his desk where it can be seen of all men; the dog of the repair man crawls under the service truck and regards the universe with a gloomy and an apprehensive eye.

The representative and the manager shake hands, and there are a few minutes of that most acute of all the forms of social torture—polite conversation; late trains, poor hotels, mean weather, warm and pleasant in New York, and so on.

Together they climb into the company car and drive out to see the plant.

The representative expects to find something wrong at the plant.

It was built by human hands; it has since been run by human intelligence; there always is something wrong at the plant.

Really the place looks clean, trim and well kept. It is in a good state of operating efficiency. But the manager is paid for this service; obviously there is no occasion for approving comment.

The manager points out, with a gleam of enthusiasm, one or two little recent improvements which he thinks will make for economy.

The representative regards them and inquires whether the manager first submitted these innovations to the home office.

If the manager says he did, the representative gives his benediction.

If the manager says he did not, the representative permits his silence to register grieved reproof.

The representative finds something wrong. He explains how it got wrong, what will happen if it is not fixed, and he gives the most minute and explicit orders about it. The manager murmurs his understanding and assent.

It is difficult to regard the timely visit of the representative at this crisis of the plant's life other than as providential.

The representative and the manager lunch together at the hotel.

This is apt to be a dull business.

The representative, with the broad outlook of the suburban commuter—his wide world vision gained in Pullman smokers and second-class hotel lobbies, naturally enough finds it difficult to adjust himself to the conversational plane of the manager, who gets his viewpoint from newspapers and books and Chamber of Commerce luncheons and loafing at odd times with the local editors, bankers and lawyers.

So there is more polite conversation at this luncheon.

He Sees the Books

In the afternoon the representative goes into the office and looks into the books—any book will do to look at.

The cashier wonders how long the bond company will give him to fix it if anything is wrong.

Every little girl remembers every error she has made since she went to work for the company.

Probably the books are all right; still more probably the representative would not know if they were wrong.

But this is not the point.

He has scared the everlasting daylights out of the whole office, which is the one impressive feature of this kind of a visitation.

There is more polite conversation with the manager.

The representative explains that the home office is getting out a new set of forms—they will be twice as long and so arranged as to provide a permanent tomb for twice the present amount of useless information.

The clouds break. The representative asks for a timetable showing the next train and one hundred dollars expense money. Willing hands assist him.

The manager drives the representative to the station and tries to find where he is going in order to send a wire of warning.

Back at the office the cashier greets the patrons with a smile and looks forward to a few more years of association with his family, the little girls salvage their gum from under their desks, the manager hangs his coat on its nail and goes to work, and the dog of the repair man resumes his benevolent watch over the yard and bites his fleas in the sun.

The visitation is over.

The voice of authority has been heard. Discipline has been maintained.

HE SEES THE HELP

To all young gentlemen who regard this general type of visitation with approbation I should like to suggest certain refinements of technic, the effect of which can reasonably be expected to improve this form of visitation.

For example, when the representative finds something wrong at the plant, instead of confining his criticism and giving his orders to the ear of the manager alone, let him call in the chief engineer and two or three workmen and then give his views and orders in the form of a lecture or discourse. The effect of this should be to emphasize the fact that, while the manager is in nominal charge, the real brains of the business is, of course, in the home office.

My suggestion upon this point should be especially helpful to the manager.

And as soon as the representative gets back to the office he should dictate to the manager's stenographer a letter to the home office.

He should report the crisis which he found at the plant.

He should inform the home office, however, that there is no cause for alarm: "Explicit orders have been given by *me* for its correction."

A copy, of course, to the manager.

HE SEES THE PUBLIC

Another suggestion: It should be desirable and useful for the representative of the home office to know the men of standing and consequence in the community where the plant operates.

He should call upon them, and of course he should go alone, leaving the manager at the office. In his conversations with these gentlemen, being a man of tact, as are all representatives of the home office, he will say no word in any way derogatory of the manager.

The representative should merely create the impression that while the manager is really a very honest, worthy person, well able to operate the physical property, naturally in the higher realm of public relations and affairs the home office expects its representatives to establish and maintain that contact.

Upon his return to the office the representative should write a second report to the home office—this time in longhand; and since the matter is outside the scope of the manager's duties, there is no occasion to give him a copy of this letter or tell him about the various conversations.

Another good way to impress the manager with the co-operative spirit of the home office is in the matter of the adjustment of grievances.

If some consumer has a quarrel over the service of the company, let the representative go alone to the aggrieved consumer and patch up the quarrel. It does not matter how it is settled—probably best by letting the consumer have his way. The important object is to let the consumer know that he can always get justice by going over the head of the manager to the wise, strong, able home office.

Upon returning to the office the representative should say to the manager that the matter is adjusted and that he will receive a letter from the home office stating the terms of settlement, under File 16-21208.

And so on.

THE OPPORTUNITY

The man who goes out from the home office to visit the local plant has a fine opportunity.

He can make his visit so helpful, so friendly, so sympathetic and so useful that the local manager and all his force will welcome his coming and will want him to stay as long as he can.

He can be a source of inspiration; if he is an inspiring kind of a man.

In a play that captured our hearts a generation ago the genial but worthless husband pointed out to his wife his great value as a bad example which the children should not follow.

That is the spirit of this article.

Measuring the Sag and Pull in an Overhead Line

FOR measuring the height of an overhead line above ground at a number of equidistant points between two towers, A. Vaupel, in a recent issue of *Elektrotechnische Zeitschrift*, suggests the use of a tall collapsible stick, made of an insulating material similar to bamboo, with a scale painted on it. One man carries the pole and a second man sights through a telescope from a selected point on a tower near the ground to a point on the same height above ground on the next tower. He reads the elevation of this second line above ground on the calibrated stick. Such measurements, made at a few points between two towers, may be drawn to scale on a cross-section sheet and will give the exact sag of the wire. A grounding wire is attached to the stick, to safeguard the man holding it in direct contact with the live transmission wire. From the sag, the known weight of the wire per unit length and the distance between the towers and the temperature during measurement the author gives a formula for calculating the pull on the wire. The use of this method and formula is explained by an example.

Demand-Meter Maintenance*

Importance of Suitable Location for Installation of Meters—Organization of Inspection and Maintenance Service—Desirable Records—Attention Required by Different Types of Instruments

By E. A. LE FEVER
Superintendent of Meters, Buffalo General Electric Company

MEASUREMENT of demand has come into general use in America only during recent years because of the fact that high-grade devices were not previously obtainable and because there was not the general attention given to the accuracy of metering that exists today. In most companies demand is measured on all large customers. The revenue derived from the demand-meter customers may run as high as 30 per cent to 50 per cent of the total gross measured revenue, though the number of such customers may be as low as 1 per cent to 2 per cent of the total number of metered customers. Because of the magnitude of the revenue dependent upon correct registration of these meters, it is exceedingly important that they be carefully installed, inspected and maintained.

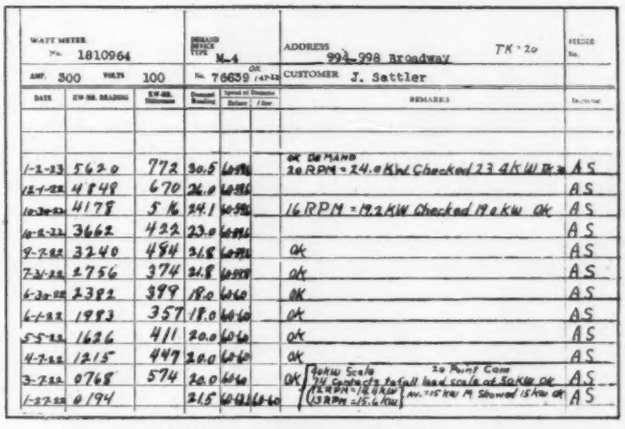
PROPER LOCATION AN IMPORTANT FACTOR

Fortunately the demand for good meter locations became general before the advent of many metered-demand contracts. If it was important to have a good location for a watt-hour meter, which was visited for test purposes only once in one, two or three years and once a month for reading, it is much more important to have demand meters installed in accessible positions, as they are visited from two times a month up to one or two times a week. In the choice of watt-hour-meter locations accessibility was not the only factor. Rightful insistence has been placed on locations for watt-hour meters which are not only accessible but free from vibration and extreme changes in temperature, reasonably light and clean. Demand meters in general are much more delicate pieces of apparatus than watt-hour meters and will not maintain their accuracy when subjected to abuse. Hence the even greater importance of selecting good locations for their installation.

It pays to have meters of all kinds installed in such a manner that the meterman has a chance to perform the duties assigned to him in a safe and accurate manner without taking unnecessary chances and with reasonable physical ease. A meter with demand attachment may be installed in a box on a pole and maintenance insisted on. But if weather conditions are not favorable, and it is raining or bitterly cold at the time of inspection, it stands to reason that this device will not receive the care it would get if it were installed in a building. Installations in unfavorable places should be avoided, and even if a slight increase in expense were necessary, avoidance of one error would often much more than pay for many such minor expenses.

Special care should be taken to give the demand maintenance inspector ample space for his work. The demand-meter auxiliary circuits should be fused to proper capacity and in such a way that the company employees may easily remove the fuses. Such auxiliary circuits should be independent of the main circuit so that the maintenance man may perform his duties without interference with the customer's service. If such precautions are not taken, there is always the possibility of short circuits, or the demand maintenance inspector may "take a chance" and say a device is "O.K." in cases where he might have done otherwise had he been provided with better means of performing his work.

One man should be in charge of all demand work. If one man cannot handle it alone, others should report directly to him. This places all the responsibility on one person and permits the shifting of work from one man to another if required because of transportation conditions, failure of devices, or difficulties which arise when one man gets behind the schedule.



WATT METER No. 1810964 — DEMAND METER TYPE M-4 — ADDRESS 993-998 Broadway TK-20 — FEEDER No.
AMP. 300 VOLTS 100 — No. 76639 OK 1-27-23 — CUSTOMER J. Sattler

DATE	KW-HR. READING	KW-HR. Difference	Demand Reading	Speed of Demand Dial	/ Disc	REMARKS	Initials
1-2-23	5620	772	30.5	60		OK DEMAND 20 RPM = 24.0 KW Checked 23.9 KW	AS
12-1-22	4848	670	26.0	60			AS
10-30-22	4178	516	24.1	60		16 RPM = 19.2 KW Checked 19.0 KW OK	AS
10-2-22	3662	422	23.0	60			AS
9-7-22	3240	484	21.8	60		OK	AS
7-31-22	2756	374	21.8	60		OK	AS
6-30-22	2382	399	18.0	60		OK	AS
6-1-22	1983	357	18.0	60		OK	AS
5-5-22	1626	411	20.0	60		OK	AS
4-7-22	1215	447	20.0	60		OK	AS
3-7-22	0768	574	20.0	60		OK 20 RPM = 24.0 KW / 16 RPM = 19.2 KW / 13 RPM = 15.6 KW — 20 Point Case 24 Contacts to full load circle at 30 KW OK — Av. 215 KW M. Showed 15 KW OK	AS
1-27-22	0194		21.5	60	60		AS

TYPICAL DEMAND-METER RECORD

The responsible head should have enough time to permit his dropping in here and there to check up the other men. Demand maintenance, like meter reading, presents a chance for abuse in that it is a routine operation and suggests the so-called "curbstone" inspection all too often encountered in meter reading. This kind of inspection is far more serious in demand work because of the revenue involved and the fact that the device is set back each month. The honest man welcomes a check on his work. This chief demand inspector should have time to go on jobs where unusual conditions exist or where doubt has been raised. A new man will often see things which others have overlooked. If there is more than one kind of device on the system, one man may well follow each kind.

It is a good policy to give a certain number of demand customers to each man and have him care for these customers continuously. He will become acquainted with the general requirements of the plant and with the personnel of at least that part of the plant which has to

*Abstract of a paper presented before the Empire State Gas & Electric Association.

do with the operation of the electrical equipment. His familiarity with both the plant and the personnel will aid materially in accounting for low or high demands and will be of considerable value on any complaint adjustment in so far as the complaint work concerns the meter department. In our organization we make it a point to have the demand maintenance inspectors keep inventory of customers' connected load and also keep in personal touch with those responsible for the electrical equipment. In the case of small demand installations which do not fall in the factory class, it is felt that this personal touch assists greatly in ascertaining that demands are correct and satisfies the customer that such is the case. The impression that knowledge of plant operation should determine the accuracy of any measurement must not be gained, but nevertheless it has a bearing which is well worth considering.

The subject of transportation should not be overlooked, especially if there is an appreciable number of devices. The demand maintenance inspector should be able to go to any device concerning the performance of which he has any doubt without a serious inconvenience or difficulty due to the time that is required to reach the location and the resulting delay of other routine inspections.

Frequency of Inspection

Frequency of inspection will depend on the types of devices. It has always been found advisable to base practice in this regard on experience and on the inherent characteristics and the dependability of the devices. When we start using a new type of device, the chief inspector handles it until he is personally familiar with it and then turns the device over to other inspectors who handle the work in the territory in which it is installed. The chief inspector retains enough of these jobs himself to familiarize himself thoroughly with the strong and weak points of the devices. New types receive at least a weekly inspection and are repeatedly checked. After the limitations of new devices are known the inspection interval is extended. It is believed the foregoing method is especially desirable in determining the reliability of devices and in the development of the demand inspectors themselves.

Inspection Records

Regular record forms should be used in inspection work. The form should carry the date, demand reading, watt-hour reading, check of time interval on certain types, and other check tests and the tester's signature. All failures should be noted on these reports and the reason for failure given if possible. Failure records should show whether the trouble was cared for or not. Unusual high or low demands should be commented upon if a reason can be assigned. It is often useful to figure the consumption in kilowatt-hours per month and compare the pro rata kilowatt-hours and demand with previous records as a means of determining the reasonableness of unusual demands.

The inspection report slips should be small in size to be easily carried and be so arranged as to give the inspector several inspection records. As these sheets are filled they should be filed so that they will be readily accessible. Definite routes should be arranged and definite schedules followed. If this be not done, lax inspection may result and a device may fail and not be detected promptly.

The "Factograph" camera has been successfully used to take photographs of all demands where the record is destroyed when the meter is read. All meters where customers are on a demand basis are read by demand maintenance inspectors. This serves as a combined inspection and reading for billing. The meter superintendent should keep a classified record of all failures under each type of device. He may class these as failures beyond the control of the demand inspector, those which are purely within the inspector's control and those which are doubtful. This classification gives an excellent check on the type of device and on the work in general, because the record can be compared from month to month and from year to year.

Demand Attachments on Kilowatt-Hour Meters

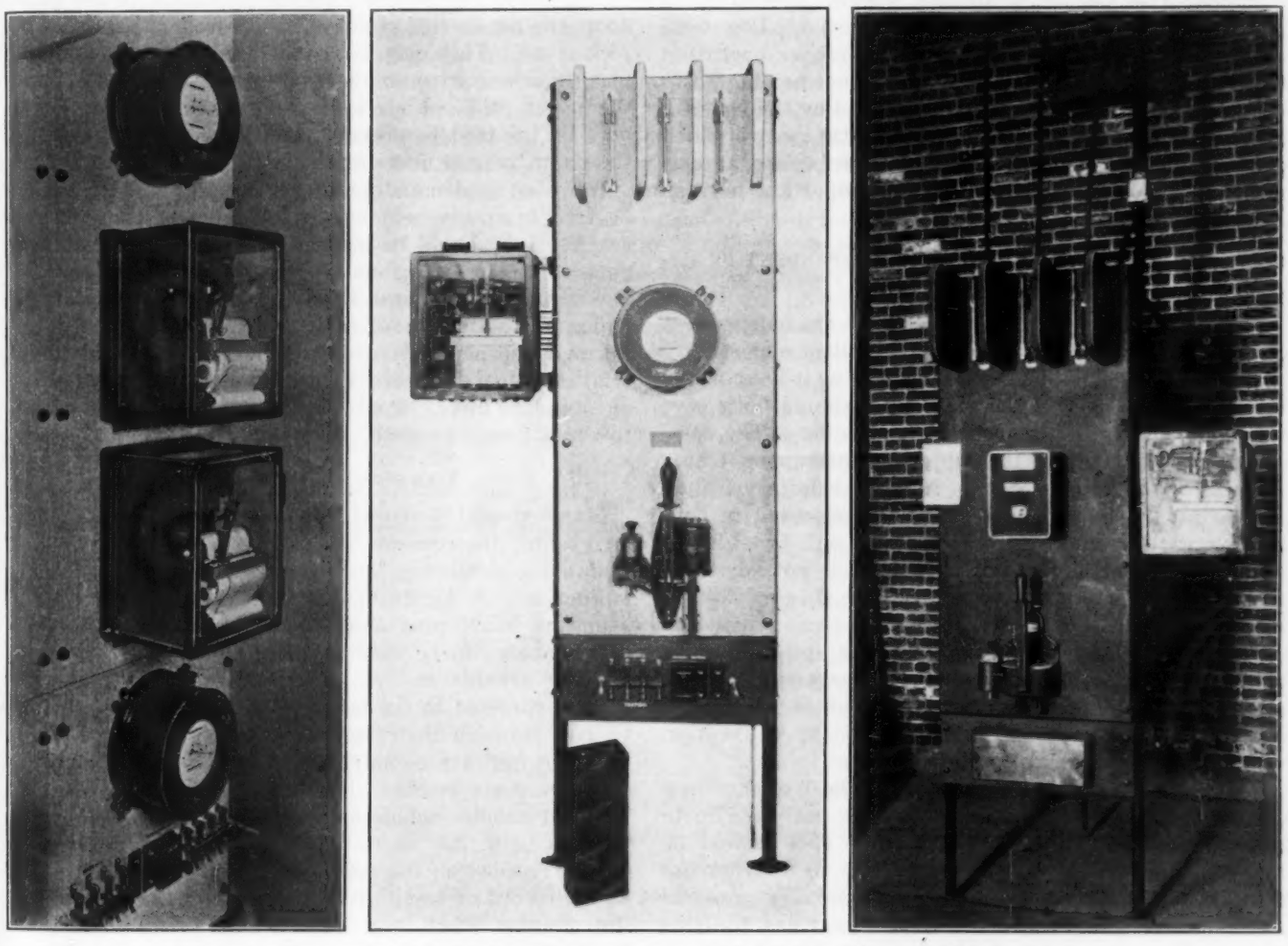
When using demand devices which are attachments to the kilowatt-hour meter, it is obvious that accuracy depends directly on the kilowatt-hour meter, and if it be a high-tension measurement, accuracy also depends on the accuracy of the instrument transformers. Instrument transformer defects are considered of great importance, and demand inspectors are required to be continually on the watch for defects. Defects will occasionally occur due to lightning or to plant disturbances caused by short circuits or other serious temporary overloads. The importance of this cannot be overestimated. They are often not as apparent as one would expect.

Where a contact mechanism is used on such meters it places additional friction load on the meter which is bound to have some effect on the light-load adjustment. Such combinations should be checked as a unit for watt-hour-meter accuracy. Demand inspectors should bear this in mind when handling such contact adjustments. The watt-hour-meter tester must also be careful about this. When necessary to change such contacts it is a good plan to retest. In the case of General Electric type M-4 devices a mid-month inspection is made, with a brief inspection at reading time. Should anything occur to throw doubt on the device at the time of the mid-month inspection, enough inspections are made before the monthly reading for billing to assure the inspector that proper demand has been obtained. Delay of billing may also be warranted by errors detected or suspected at the time of reading inspection. Contacts on such devices should be watched carefully to be sure they are clean and operate properly. The revolutions of the watt-hour meter should be compared with the impulses registered on the demand scale to obtain a complete check on the device. It is not necessary to do this for the entire interval. The speed of the timing element should be taken at each mid-month inspection. Meshing of teeth between the demand register and the timing shaft should be carefully noted each time a demand register is removed, since serious errors may occur, especially in the older types. If not watched off-scale reading may result from poor meshing or complete disengagement of the gears, and a high demand may result in the case of serious friction due to excessive meshing.

Occasionally a glass cover may bear down on the demand scale, causing improper registration which cannot be found when the cover is removed. The reset mechanism should be watched to see that it returns to zero. Occasionally, too, a contact coil or other wiring device within the meter may open circuit or, worse still, may develop a loose connection. These things should be watched.

In the case of direct-current measurements the General Electric type M-5 and M-6 devices are widely used. Previous comments apply to these except as regards the timing device. The M-5 timing device is an eight-day clock, and, though it is a good clock, it is subject to all the troubles found in any high-grade clock. Any clock mechanism must be kept clean. It cannot be installed and expected to run indefinitely without cleaning. Clock mechanisms should be cleaned at least once a year. It is a good plan to care for a portion of these each month. When cleaning, the clock should be taken entirely apart and all parts washed in gasoline. Damaged balance wheels and roughened jewels should be replaced by new parts. A small pocket magnifying glass should be taken to see that the mainspring is run down before attempting to disassemble these clocks. This is especially true in the M-5 type. Clock cleaning should always be done in the meter shop. The best results will probably be obtained if the regular maintenance inspector cares for this work unless the department is fortunate enough to have a real clock man on its staff. Good clock men are born and not trained. However, with careful training good results can be obtained. The average jeweler is of little value.

The M-6 device has an advantage over the M-5 in that it does not have to be wound once each week. If the M-5 is not wound on a very definite schedule each week, there is naturally a chance of losing the demand.



SOME TYPICAL DEMAND-METER INSTALLATIONS WITH FACILITIES AT BOTTOM FOR TESTING

will be found useful for examining shafts; a needle is best for examining the jewels. After thoroughly drying, all bearings should be cleaned with orangewood sticks, and any gum or other foreign matter which may adhere to the shaft ends should be removed. After being reassembled the clock should be thoroughly oiled with high-grade oil.

The General Electric Company recommends a high-grade mineral oil known as "Finol" for this service. This company discourages the use of fish oil especially on the M-6 meter. A twenty-four-hour run after cleaning and before installing is an excellent plan. Attempts to clean a demand clock by immersing it in gasoline (without disassembling), allowing it to dry and then oiling should be avoided. The instrument may run after such treatment and it may not. Do not blame the clock if it does not run with such treatment. Care A clean and smooth commutator is essential to good operation of the M-6 device.

Eight-day key clocks have the same disadvantage in connection with graphic demand meters that they have when used in other devices, in that they require visits at a definite time. The electric clock on the Westinghouse M graphic meter has a reserve of thirty minutes minimum to sixty minutes maximum, which cares for ordinary power interruptions. The control potential transformer should be connected ahead of the main-line oil switch except in cases where the customer never opens the main-line oil switch.

The General Electric type M-7 and the Westinghouse type OA demand attachments are similar in many respects to the M-4 devices. The timing element is in the meter itself. These devices present very much the same problems described above. Contacts are, of course,

absent. The meter cover must be removed for any extended inspection. Care must be taken to see that dirt does not get into the meter. These devices are not recommended for use on installations requiring much over 50 kw.

The General Electric type G device has many elements in common with those previously described. It operates from contacts on the watt-hour meter and has an eight-day clock mechanism if it is not operated by a Warren motor. Care must be exercised in the handling of the waxed charts. The stylus must be handled carefully as a blunt point will result in indistinct charts. Tension on the stylus spring has a very material effect on clearness of the chart. The General Electric Company recommends the use of a definite weight applied in a definite manner to test this spring tension. Low temperatures may cause trouble securing proper operation of the stylus. The temperature should not be allowed to go below freezing; this can be prevented by the use of a special heating element with thermostatic control which can be obtained from the manufacturer. Zero adjustments and clock maintenance are as important here as in other similar types.

GRAPHIC METERS WHICH ARE INDEPENDENT OF WATT-HOUR METERS

With the various graphic types which are independent of the watt-hour meter, there is an excellent opportunity to check the demand device against the watt-hour meter by means of a stop watch since they should both give the same results independent of each other. The comments already made on the subject of instrument transformers apply equally here. A very definite schedule of placing the paper chart should be observed in connection with graphic meters or there will be either a loss of record or a waste of paper. It is not advisable to attempt to splice the paper because this may often result in failure of the record. Each time a new roll of paper is placed in a graphic meter its zero mark should be checked and adjusted if necessary. At the same time Westinghouse graphic meters should be checked for center scale by means of the calibration weight provided by the manufacturer.

The motor-control graphic meter of the Westinghouse company has a few features which are not common to the solenoid-control type. With these care should be taken not to set the contacts too close or the moving contact arm may bridge the two stationary contacts and burn out the motor. Fuses are provided for this motor. However, owing to the fine wire in motor winding, special care should be taken not only that the proper size of fuses is used but that the fuses will blow at their rated current. The cam or helix curve is an important consideration in this meter. In the event of wear it may be necessary to replace it.

Many graphics which are subjected to widely fluctuating loads will require special adjustment of the solenoid dashpots to prevent drawing too wide a curve. Individual graphic meters should be so adjusted after they are in position and operating. Solenoid dashpots ought to be cleaned out once a year. In removing them care should be taken not to dent them or serious errors will result. The glycerine level in the small dashpot connected to the balance arm should be carefully noted when installed and maintained at this point as the accuracy of the device will be affected thereby. Excessive vibration may change the level and produce serious errors.

Paper collection should be made about once a week, although with the motor reroll used by this company three times a month will suffice. If allowed to go too long, the reroll will carry so much paper that it is liable to catch under the drum. Paper should be dated, and if any record is lost, the fact should be noted. Each graphic meter inspector should go over each roll and see if there are any troubles indicated on the paper. If so, he should correct them.

Catching of paper under the driving drum is an old difficulty which is due to several causes, but which may be lessened to some extent, depending on the ingenuity of the maintenance inspector. For example, widely fluctuating loads cause considerable ink to be deposited on the chart. If the ink comes in contact with the glass door, the paper will stick and the reroll paper will not pick it up. This may be avoided to a great extent by placing a seal wire on the surface of the glass so that the paper will not strike it; or an extra idler roller may be inserted to prevent used paper from following the drum around under the roll.

Ink used in demand-meter registering devices should be free from any sediment or clogging of the pen will result. Ink should be strained through chemical filter paper. After trying many ink combinations, we are now using the General Electric No. 6 formula ink, to which we add pure glycerine, using about two parts ink and one part glycerine to thicken it. Many industrial customers' meters would not run through a week on standard inks. Pens are filled from once a month to three times a month, always using fresh ink.

TOOLS AND METER TESTS

Many special tools will suggest themselves for use on graphic instruments such as a grinding device for truing the armature commutators. A special tool for pulling out sticky dashpots, punches for pressing out armature shaft pins and other such useful and time-saving tools can be used to advantage.

Since graphic meters used to measure demand are usually confined to the larger installations, they should be run through their entire scale by use of phantom load and indicating instruments from once a month to once every six months, depending on their importance. The test should include ascending and descending readings on both the "as found" and "as left tests," these being recorded on the actual chart paper and turned in as the record of test. Before the "as left" test is made the graphic clock and other mechanism should be thoroughly cleaned mechanically and electrically. We do this on the job, using the small motor device previously referred to for truing the commutators on the graphic-instrument motors. Such tests should be strictly the duty of the demand maintenance inspector who is in charge of the graphic meters. Installation tests are also advisable.

It should be remembered that the graphic meter of almost any manufacture is one of the most delicate pieces of mechanism that is used in billing. Hence it must receive scrupulous care. If it is properly maintained on customers' premises, it will produce excellent results.

Too much emphasis cannot be placed on the fact that because some weakness may seem to be apparent in the above comments we should be very slow to condemn any device. The measurement of demand is a very different problem from that of a measurement of kilowatt-hours, necessitating far more complicated and delicate devices.

Trend of Electrical Construction Costs

Price Fluctuations of Major Items Composing Electric Light and Power Construction Work During Past Twelve Years—Index Curves Facilitate Estimates of Past and Future Construction

By WILLIAM W. HANDY
Consulting Engineer, Baltimore, Md.

IN CONNECTION with a valuation made by the author of this paper in the last three years, covering the property of a large gas and electric light and power public utility company in the Middle Atlantic States, there was occasion for the preparation of a rather unusually elaborate set of cost analyses of construction work, involving the determination of the relative costs of the several major elements making up the totals of various capital accounts, together with the unit costs of all of these elements and the percentage fluctuations in these costs over a period of years from 1911 to 1922 inclusive. During this period, as is well known, prices rose from the pre-war normal level to the war and post-war peaks, and subsequently fell to the minimum post-war level in 1921, from which in turn they have been on the average increasing to a greater or less extent during the year 1922, with the exception of equipment generally, the price trend of which has been downward.

As these cost analyses were prepared on an unusually comprehensive scale and covered such an extended period, it appeared that they afforded an excellent opportunity for the preparation of cost-index numbers and cost-index charts which would be of value to the industry and which would make it possible to tell at a glance the price trend of all major labor and material factors entering into the construction of a property and the price trend of each different kind of construction work, together with the price trend of the property as a whole, including buildings, power-plant and substation equipment, distribution system and all other items, including customers' installations. Furthermore, by the periodic posting of these index numbers and charts it appeared that the trend of construction costs could be continued and a record made which would be of permanent value through future years. While information similar to this is available in the form of the well-known cost indexes published by the United States Department of Labor and by the Bradstreet and Dun organizations and others, and while certain manufacturing and construction companies also maintain such records for the apparatus which they manufacture and for the work which they do, it appears that there is no similar service in effect especially applicable to public utility properties such as those of electric light and power companies. With this end in view the cost analyses made of the electric division of the public utility property in question have been used to prepare the cost-index charts presented in this paper, a brief explanation being herewith presented to set forth as clearly as possible the method used in the making of the analyses and in the preparation of the charts.

Buildings.—Costs of buildings, divided into reinforced concrete and brick types of construction as erected by the company,

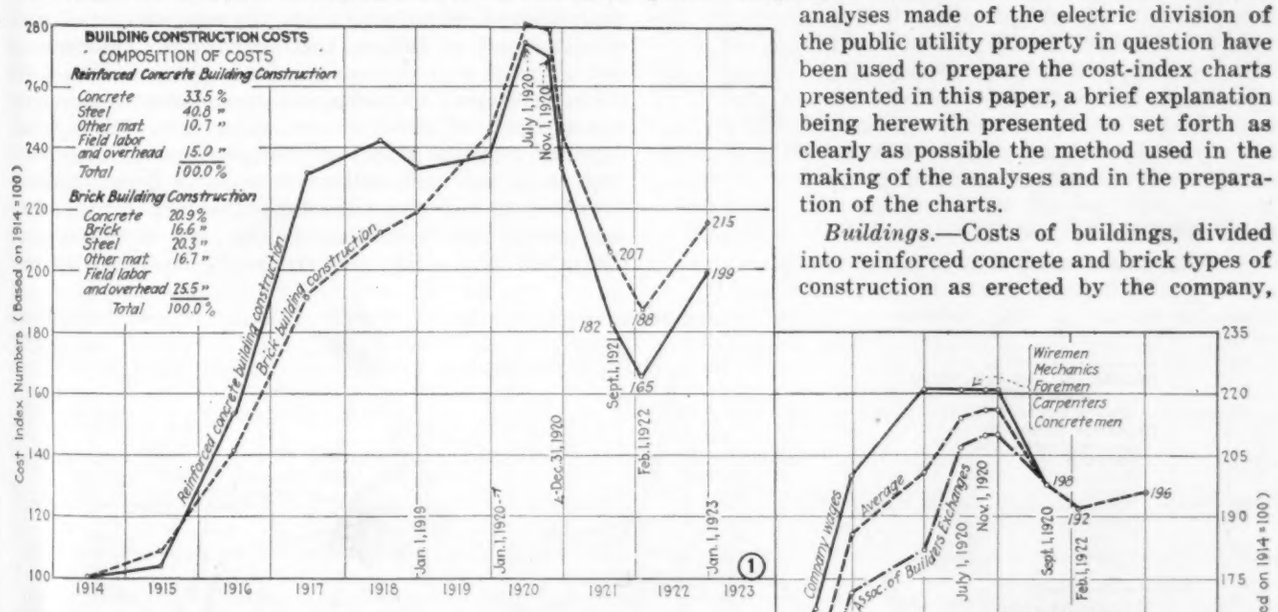


FIG. 1—BRICK AND CONCRETE CONSTRUCTION NOW 65 TO 81 POINTS BELOW PEAK PRICE AND RISING

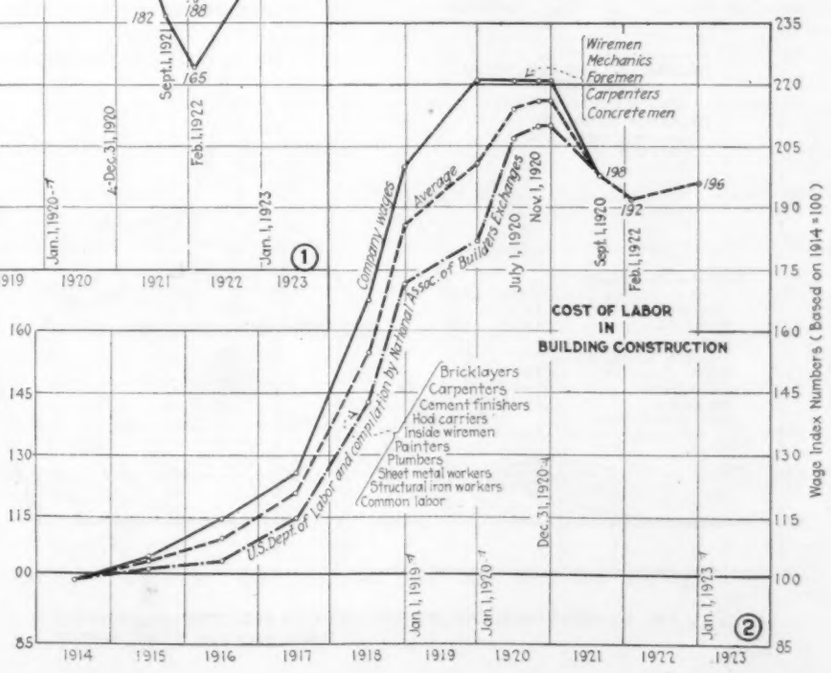


FIG. 2—LABOR COSTS HIGHER THAN IN FEBRUARY, 1922, BUT RISING

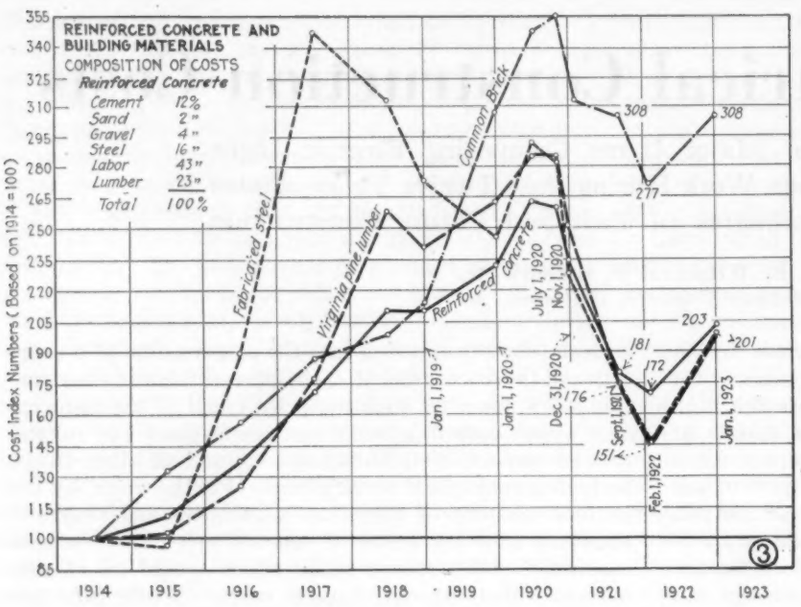


FIG. 3—OF ALL BUILDING MATERIALS BRICK HAS REDUCED LEAST

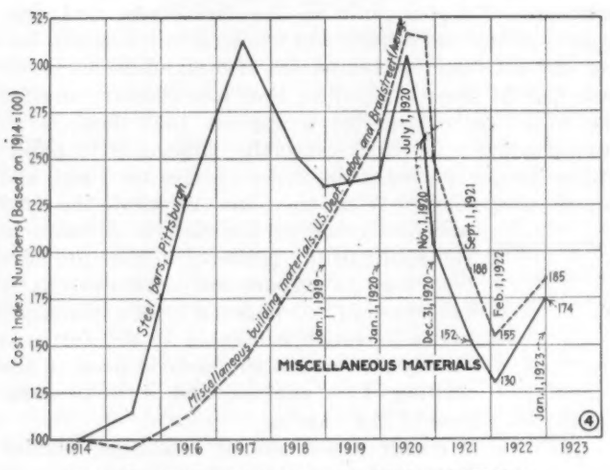


FIG. 4—MISCELLANEOUS BUILDING MATERIALS

were separated into the elements making up the cost, comprising cost of concrete in place, brick delivered, steel delivered, other materials and field labor and overhead costs. The percentage of each of these elements to the total costs was determined, together with the percentage of fluctuations in unit costs of each of these elements over the period from 1911 to 1922 inclusive. Weighted percentage fluctuations in the costs of these elements were then figured, the total of the weighted percentages plus a base figure of 100 giving the cost-index numbers of the two types of construction over the period, and from these the index curves as shown on Chart 1 were prepared.

Supporting the analyses from which Chart 1 was made, detailed analyses of the unit costs of reinforced concrete and the various elements entering into it were compiled and the percentage fluctuations in the unit costs of these elements from 1911 to 1922 inclusive determined, the same analyses being made of the costs of brick, structural steel, miscellaneous building material and the various kinds of field labor entering into building construction. The cost-index curves prepared from these analyses are shown on Charts 2, 3 and 4.

Mechanical Equipment.—An analysis of mechanical equipment as a whole entering into the total cost of power stations was prepared in a manner similar to the analysis made of building costs, the relative cost of each element, such as boilers, turbo-generators (mechanical end), piping, coal and ash handling, stokers and auxiliaries, condensers and tubes and pumps, and the percentage of each of these to the total cost, determined, together with the actual and weighted percentage fluctuations in the unit costs of these same elements from 1911 to 1922 inclusive, the total of the weighted percentages giving the fluctuations in the costs of mechanical equipment as a whole over the period, from which the

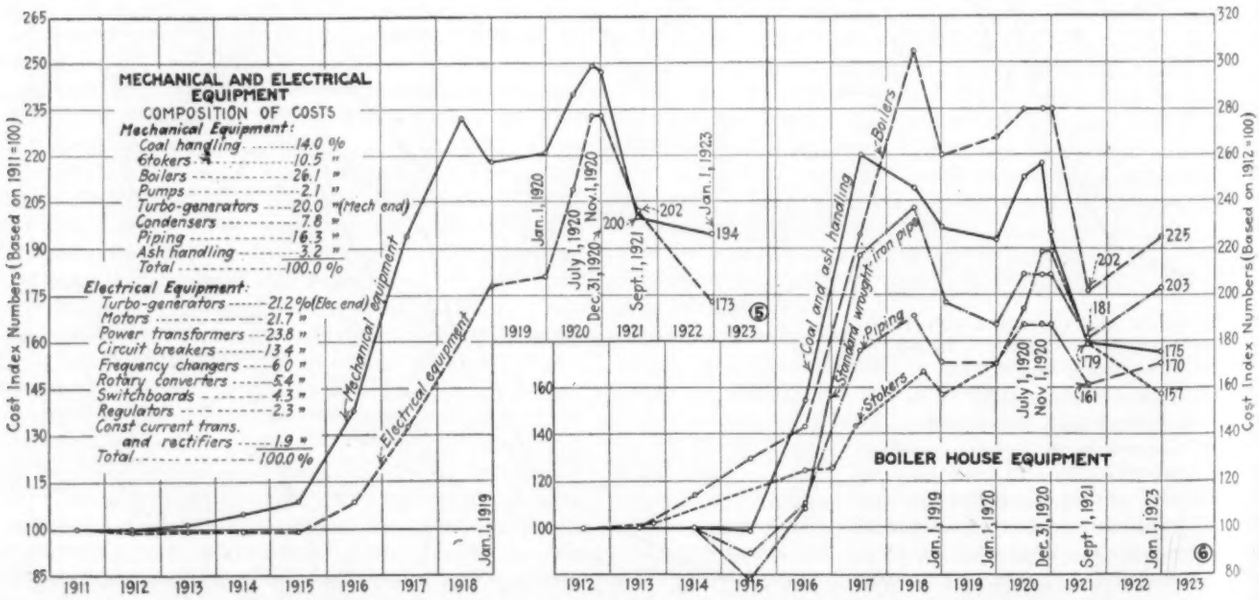


FIG. 5—ELECTRICAL EQUIPMENT ONLY 73 PER CENT ABOVE PRE-WAR LEVEL. FIG. 6—STOKER PRICES MORE REDUCED THAN BOILER

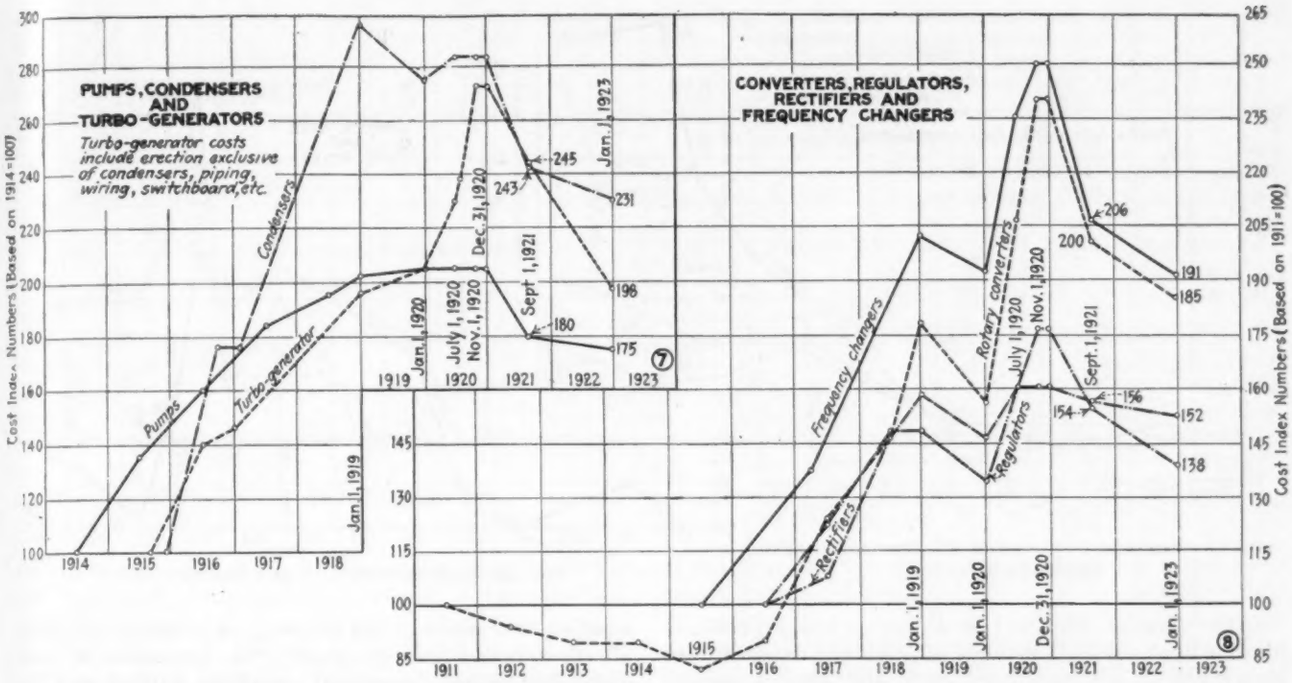


FIG. 7—TURBO-GENERATORS 72 POINTS BELOW PEAK PRICE; CONDENSERS 131 POINTS ABOVE 1914 PRICES. FIG. 8—FREQUENCY CHANGERS STILL 91 PER CENT ABOVE PRE-WAR LEVEL; RECTIFIERS ONLY 38 PER CENT ABOVE

index-cost curve shown on Chart 5 was prepared, the cost index curves for boilers and the other elements of mechanical equipment being illustrated in the curves of Charts 6 and 7.

Electrical Equipment.—A similar analysis to that made for mechanical equipment was made for electrical equipment entering into the total cost of generating stations and substations, relative cost determined of each element such as turbo-generators (electrical end), motors, power transformers, oil switches, frequency changers, rotary converters, switchboards, induction regulators and constant-current transformers and rectifiers, and the percentage of each of these to the total cost, together with the actual and weighted percentage fluctuations in these same elements from 1911 to 1922 inclusive, the total of the weighted percentages giving the fluctuations in the cost of electrical equipment as a whole over the period, from which the index cost curve shown on Chart 5 was prepared, the cost-index curves for frequency changers, and the other elements of electrical equipment being shown in the curves plotted in Charts 8 and 9.

Poles and Fixtures.—Cost analyses of poles and fixtures were made similarly to the analyses of buildings and mechanical and electrical equipment. The relative costs of chestnut poles, cross-arms, braces and racks, guys, miscellaneous material, labor, hauling and overhead costs, and the percentage of these to the total cost, were determined, together with the actual and weighted percentage fluctuations in the costs of these same elements from 1911 to 1922 inclusive, the total of the weighted percentages giving the fluctuations in the cost of poles and fixtures as a whole over the period in question, from which the cost-index curve shown on Chart 10 was prepared, the index curves for poles, cross-arms and other elements entering into the cost of poles and fixtures being shown in the curves composing Charts 11 and 16.

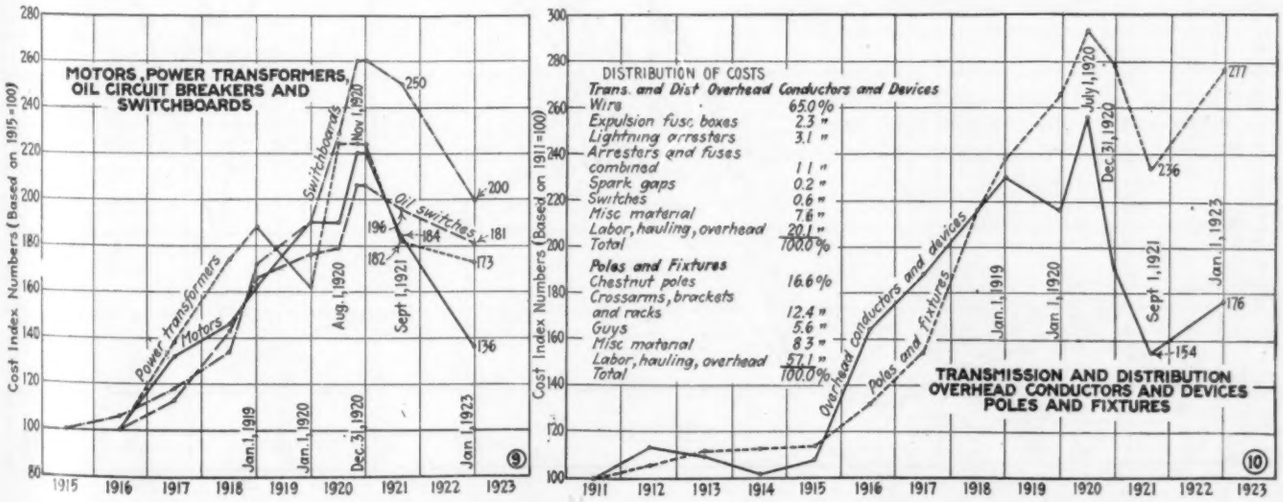


FIG. 9—OIL SWITCHES STILL 100 PER CENT UP, BUT MOTORS SHOW GREATER REDUCTION. FIG. 10—POLES AND FIXTURES NEAR PEAK PRICES; CONDUCTORS LOW BUT RISING

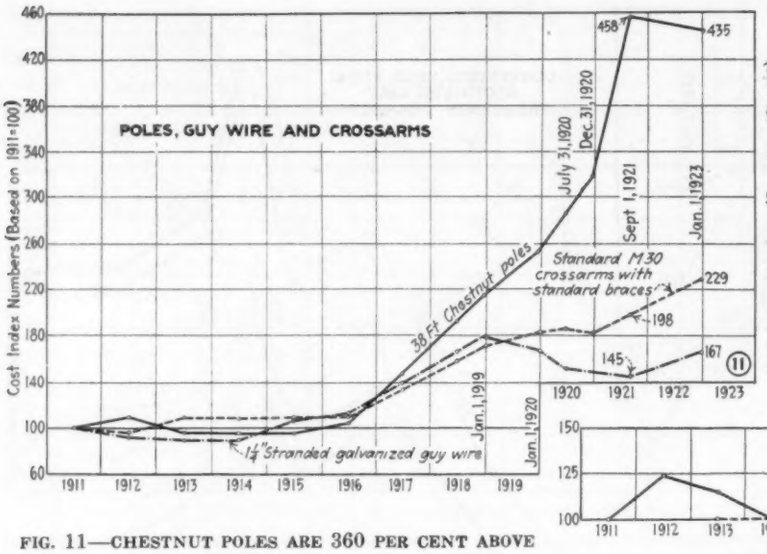


FIG. 11—CHESTNUT POLES ARE 360 PER CENT ABOVE PRE-WAR NORMAL

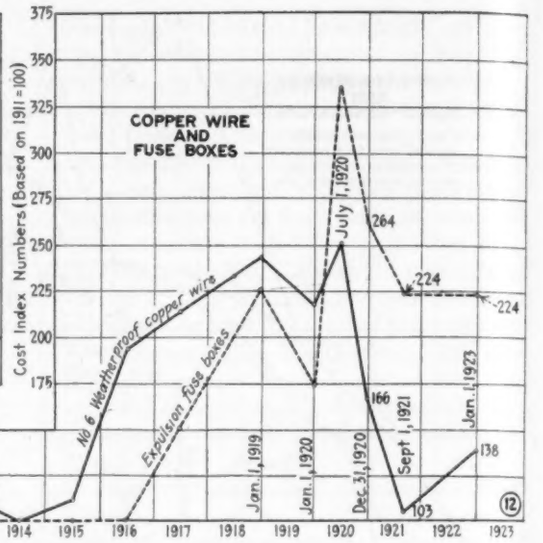


FIG. 12—COPPER WIRE LOW BUT RISING

Other Capital Accounts or Kinds of Construction.—Similar analyses to that made of poles and fixtures were also made of overhead conductors and devices, underground conductors, municipal street lighting, customers' services, electric house meters, distribution or line transformers, arc and glower lamps and customers' electric installation, the cost-index curves for these being shown on Charts 10, 13, 14 and 15 and the cost-index curves for copper wire, underground cable and the other elements entering into the costs of the above several kinds of construction being shown on Charts 12, 13 and 16.

Total Construction and Equipment.—Finally a cost analysis was made of the property as a whole, including all construction and equipment, but exclusive of land, unfinished plant investment, working capital and intangibles, such as organization and development, cost of obtaining capital, etc., and the relative cost was determined of each element entering into the total, including buildings and structures, mechanical equipment, electrical equipment, poles and fixtures, overhead conductors and devices, underground conductors, line transformers, arc lamps, municipal street lighting, customers' services, customers' meters and customers' installation, the actual percentage fluctuations in each of these elements for the

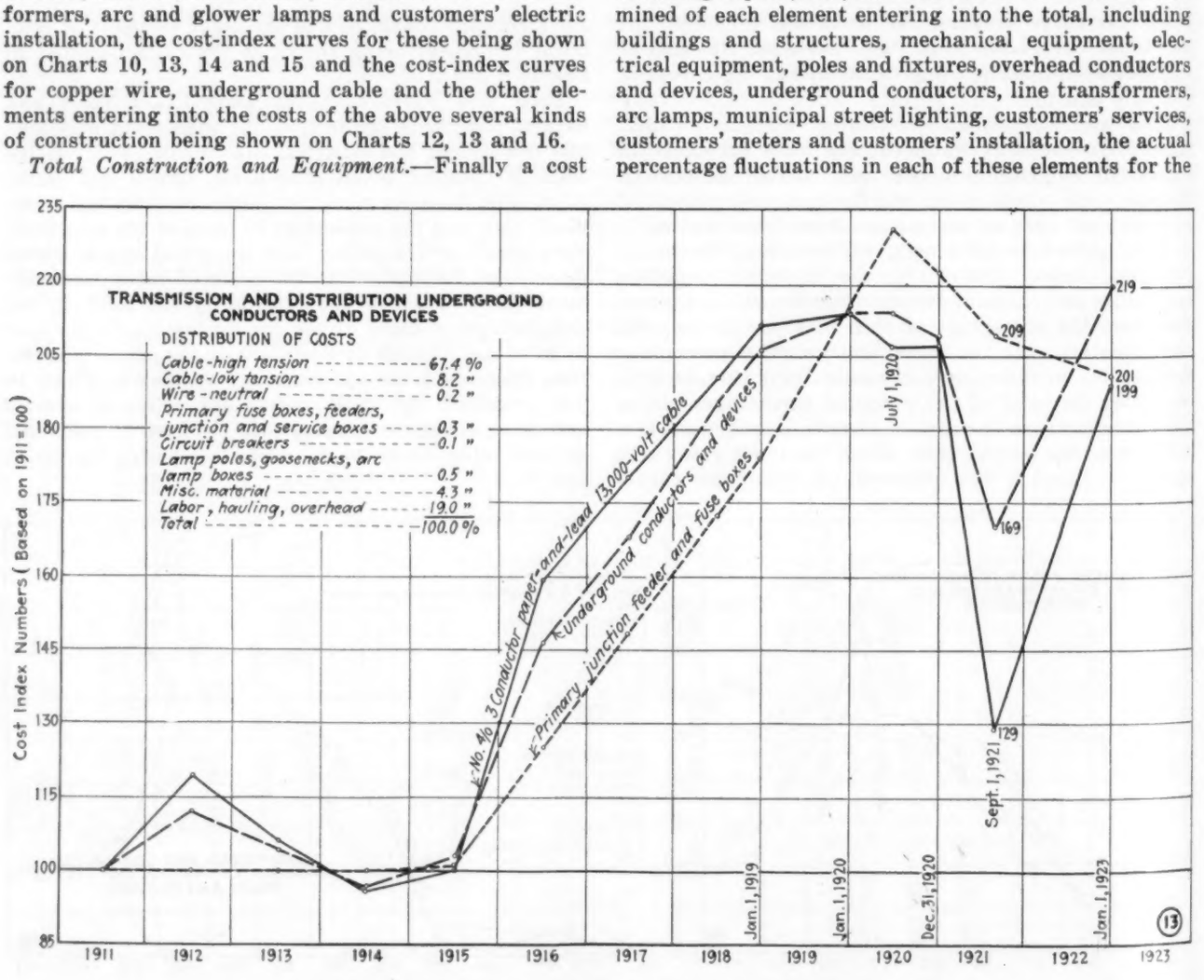

TRANSMISSION AND DISTRIBUTION UNDERGROUND CONDUCTORS AND DEVICES
DISTRIBUTION OF COSTS
Cable-high tension ---------- 67.4 %
Cable-low tension ---------- 8.2 "
Wire-neutral ---------- 0.2 "
Primary fuse boxes, feeders, junction and service boxes ---------- 0.3 "
Circuit breakers ---------- 0.1 "
Lamp poles, goosenecks, arc lamp boxes ---------- 0.5 "
Misc. material ---------- 4.3 "
Labor, hauling, overhead ---------- 19.0 "
Total ---------- 100.0 %
Cost Index Numbers (Based on 1911=100)
No. 4/0 3 Conductor paper-and-lead 13,000-volt cable
Underground conductors and devices
Primary junction feeder and fuse boxes
July 1, 1920
Sept. 1, 1921
Jan. 1, 1919
Jan. 1, 1920
Dec. 31, 1920
Jan. 1, 1923
219
209
201
199
169
129
13

FIG. 13—UNDERGROUND EQUIPMENT NEAR PEAK PRICES AND RISING

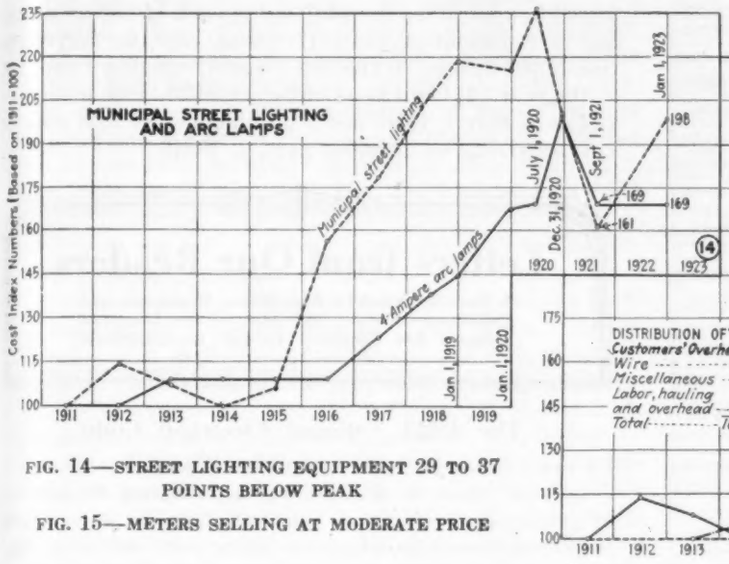


FIG. 14—STREET LIGHTING EQUIPMENT 29 TO 37 POINTS BELOW PEAK

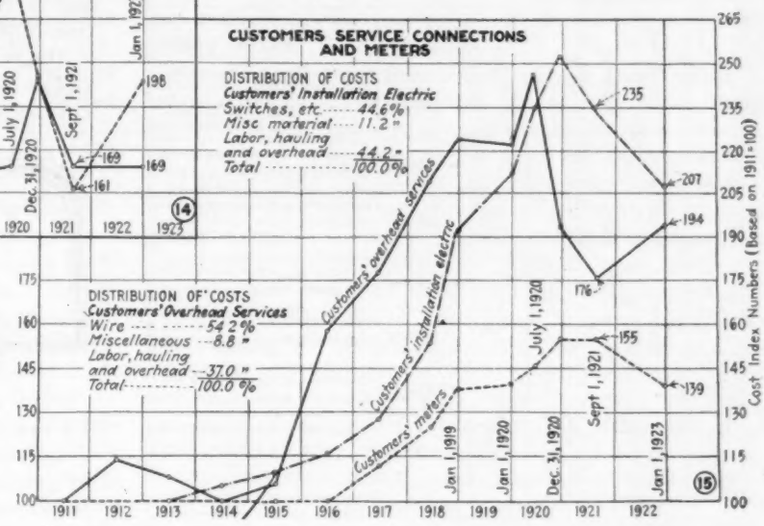


FIG. 15—METERS SELLING AT MODERATE PRICE

period being taken from the analyses already made and the weighted percentage fluctuations being calculated therefrom, the total of the weighted percentages giving the fluctuations in the cost of construction and equipment as a whole from 1911 to 1922 inclusive, from which the cost-index curve for the entire property shown on Chart 17 was prepared. From this chart it will be noted that the cost index for a large electric light and power utility such as the one in question rose from the pre-war level in 1911 to a maximum in July, 1920, decreased from this date through the latter part of 1920 and through 1921 up to September, and from that date has been slowly rising through the past year to Jan. 1, 1923, as of which date the analyses were completed and at which time the cost index was 194, showing an increase over the pre-war period of 94 per cent.

DERIVATION OF INDEX FIGURES

For the purpose of illustrating still more effectively the method used and its application in deriving the cost-index figures from which the charts presented in this paper were derived, the table on page 864 gives the derivation of the indexes for total construction and equipment. By reference to this tabulation it will be noted that the upper part of it gives the actual costs under each capital account covering its particular kind of construction, including buildings and structures, mechanical equipment, electrical equipment, poles and fixtures, overhead conductors and devices, underground conductors, and so on down to customers' installation, together with the percentage each of these sub-totals bears to the total of all construction and equipment.

The lower part of the tabulation gives for each capital account the percentage fluctuation in cost for its particular kind of construction from 1911 to 1922 inclusive, together with the weighted percentage fluctuations in cost for each by years, the latter being derived by multiplying its percentage of the total cost of all construction and equipment by the actual percentage fluctuations, the actual percentages having been first derived from similar tabulations giving the cost analyses of each kind of construction—such, for example, as buildings and structures, which was made up from an analysis of the unit costs and percentage fluctuations in costs for each construction element (sand, gravel, cement, brick, structural steel, lumber, etc.) and the various kinds of building labor.

Again referring to the tabulation, the sums of the weighted percentages of buildings and structures, mechanical equipment, electrical equipment, etc., for each year were taken, giving the percentage fluctuations in cost for construction and equipment as a whole over the period, from

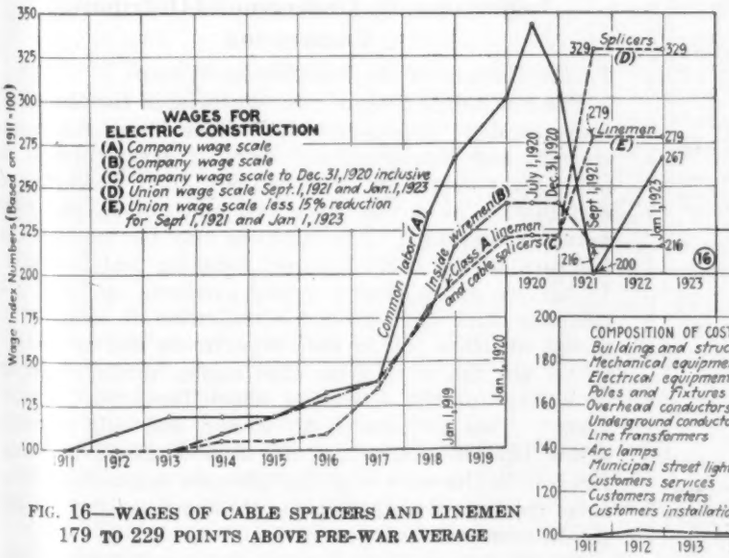
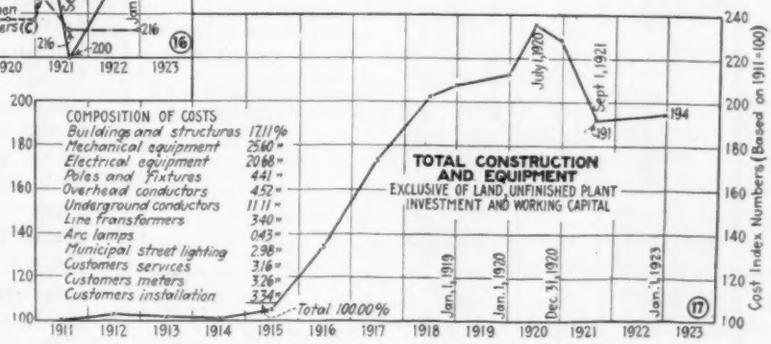

WAGES FOR ELECTRIC CONSTRUCTION
(A) Company wage scale
(B) Company wage scale
(C) Company wage scale to Dec. 31, 1920 inclusive
(D) Union wage scale Sept. 1, 1921 and Jan. 1, 1923
(E) Union wage scale less 15% reduction for Sept 1, 1921 and Jan 1, 1923
Common labor (A)
Inside journeyman (B)
Class A linemen and cable splicers (C)
Splicers (D)
Linemen (E)
329
279
267
216
200
July 1, 1920
Dec. 31, 1920
Sept 1, 1921
Jan 1, 1923
Jan 1, 1919
Jan 1, 1920
Wage Index Numbers (Based on 1911=100)
1911 1912 1913 1914 1915 1916 1917 1918 1919 1920 1921 1922 1923
16

FIG. 16—WAGES OF CABLE SPLICERS AND LINEMEN 179 TO 229 POINTS ABOVE PRE-WAR AVERAGE

FIG. 17—TOTAL CONSTRUCTION COST 94 PER CENT ABOVE PRE-WAR BASIS, BUT RISING SLOWLY


COMPOSITION OF COSTS
Buildings and structures 17.11%
Mechanical equipment 25.60 "
Electrical equipment 20.68 "
Poles and Fixtures 4.41 "
Overhead conductors 4.52 "
Underground conductors 11.11 "
Line transformers 3.40 "
Arc lamps 0.43 "
Municipal street lighting 2.98 "
Customers services 3.16 "
Customers meters 3.26 "
Customers installation 3.34 "
Total 100.00%
TOTAL CONSTRUCTION AND EQUIPMENT
EXCLUSIVE OF LAND, UNFINISHED PLANT INVESTMENT AND WORKING CAPITAL
July 1, 1920
Sept 1, 1921
194
191
Jan 1, 1919
Jan 1, 1920
Dec. 31, 1920
Jan 1, 1923
Cost Index Numbers (Based on 1911=100)
1911 1912 1913 1914 1915 1916 1917 1918 1919 1920 1921 1922 1923
17

CONDENSED SUMMARY OF ANALYSES OF ACTUAL COSTS OF TOTAL CONSTRUCTION AND EQUIPMENT (ELECTRIC DIVISION)*
(Costs and Percentages of Total)

Buildings		Mechanical Equipment		Electrical Equipment		Poles and Fixtures		Overhead Conductors		Underground Conductors		Line Transformers		Arc Lamps		Municipal Street Lighting		Customers' Services		Customers' Meters		Customers' Installation		Totals	
Cost	Per Cent	Cost	Per Cent	Cost	Per Cent	Cost	Per Cent	Cost	Per Cent	Cost	Per Cent	Cost	Per Cent	Cost	Per Cent	Cost	Per Cent	Cost	Per Cent	Cost	Per Cent	Cost	Per Cent
$4,029,412	17.11	$6,029,672	25.60	$4,870,037	20.68	$1,039,137	4.41	$1,061,303	4.52	$2,625,865	11.11	$800,318	3.40	$101,939	0.43	$702,890	2.98	$744,332	3.16	$767,251	3.26	$786,516	3.34	$23,558,671	100.00

PERCENTAGE OF COST FLUCTUATION BASED ON STUDY OF PRICE FLUCTUATIONS IN MATERIAL AND LABOR

Date of Construction	Buildings		Mechanical Equipment		Electrical Equipment		Poles and Fixtures		Overhead Conductors		Underground Conductors		Line Transformers		Arc Lamps		Municipal Street Lighting		Customers' Services		Customers' Meters		Customers' Installation		Totals		Cost Numbers
	Actual	Weighted	Actual	Weighted	Actual	Weighted	Actual	Weighted	Actual	Weighted	Actual	Weighted	Actual	Weighted	Actual	Weighted	Actual	Weighted	Actual	Weighted	Actual	Weighted	Actual	Weighted	Actual	Weighted	
1911	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	100
1912	0.0	0.0	0.0	0.0	0.0	0.0	7.0	0.3	16.0	0.7	14.0	1.6	0.0	0.0	0.0	0.0	15.0	0.4	13.0	0.4	0.0	0.0	0.0	0.0	3.4	3.4	103
1913	0.0	0.0	0.0	0.0	—1.0	—0.2	12.0	0.5	10.0	0.5	5.0	0.6	0.0	0.0	9.0	0.0	8.0	0.2	8.0	0.3	0.0	0.0	0.0	0.0	1.9	1.9	102
1914	0.0	0.0	4.0	1.0	—1.0	—0.2	14.0	0.6	1.0	0.0	—3.0	—0.3	0.0	0.0	9.0	0.0	6.0	0.2	2.0	0.1	0.0	0.0	4.0	0.1	1.4	1.4	101
1915	5.0	0.9	8.0	2.0	—1.0	—0.2	32.0	1.4	8.0	0.4	47.0	5.2	0.0	0.0	9.0	0.0	55.0	1.6	56.0	1.8	0.0	0.0	9.0	0.3	4.8	4.8	105
1916	50.0	8.6	38.0	9.7	10.0	2.1	64.0	2.9	64.0	2.9	69.0	7.7	8.0	0.3	9.0	0.0	79.0	2.4	79.0	2.5	12.0	0.4	17.0	0.6	33.9	33.9	134
1917	122.0	20.9	94.0	24.1	33.0	6.8	55.0	2.4	88.0	4.0	95.0	10.6	46.0	1.6	23.0	0.1	79.0	2.4	79.0	2.5	12.0	0.4	28.0	0.9	72.5	72.5	173
1918	134.0	22.9	132.0	33.8	62.0	12.8	116.0	5.1	117.0	5.3	108.0	12.0	58.0	2.0	44.0	0.2	119.0	3.5	124.0	3.9	39.0	1.3	54.0	1.8	106.6	106.6	207
Jan. 1, 1919	129.0	22.1	118.0	30.2	79.0	16.3	139.0	6.1	131.0	5.9	108.0	12.0	58.0	2.0	44.0	0.2	119.0	3.5	124.0	3.9	39.0	1.3	92.0	3.1	106.6	106.6	207
Jan. 1, 1920	140.0	24.0	121.0	31.0	81.0	16.8	165.0	7.3	119.0	5.4	115.0	12.8	46.0	1.6	67.0	0.3	117.0	3.5	123.0	3.9	40.0	1.3	112.0	3.7	111.6	111.6	212
July 1, 1920	175.0	29.9	140.0	35.8	109.0	22.5	194.0	8.6	157.0	7.1	116.0	12.9	60.0	2.0	69.0	0.3	137.0	4.1	147.0	4.6	46.0	1.5	133.0	4.4	133.7	133.7	234
Dec. 31, 1920	136.0	23.3	147.0	37.6	133.0	27.5	178.0	7.8	91.0	4.1	110.0	12.2	76.0	2.6	99.0	0.4	100.0	3.0	94.0	3.0	55.0	1.8	151.0	5.0	128.3	128.3	228
Sept. 1, 1921	88.0	15.1	100.0	25.6	102.0	21.1	136.9	6.0	54.0	2.4	69.0	7.7	54.0	1.8	69.0	0.3	61.0	1.8	76.0	2.4	55.0	1.8	135.0	4.5	90.5	90.5	191
Jan. 1, 1923	103.0	17.6	94.0	24.1	73.0	15.1	177.0	7.8	76.0	3.4	120.0	13.3	38.0	1.3	69.0	0.3	98.0	2.9	94.0	3.0	39.0	1.3	107.0	3.6	93.7	93.7	194

* Exclusive of costs of land, unfinished plant investment and working capital.

which figures, after the addition to each of 100 as a base and as representing the 1911 normal cost, we derive the cost-index figures in the last column, ranging from 100 in the year 1911 to 194 as of Jan. 1, 1923, with a peak of 234 as of July 1, 1920, and a minimum since that date of 191, occurring on or about Sept. 1, 1921.

Letters from Our Readers

A Place Set Apart for Suggestions, Comments and Criticisms, to Which All Men of the Electrical Industry Are Cordially Invited to Contribute

The 1923 National Electrical Code

To the Editors of the ELECTRICAL WORLD:

In your issue of March 24 you published an account of proposed revisions of the National Electrical Code. Numerous inquiries which are being received by me and by inspection departments suggest that it is well to describe the present status of these rules. It should not be assumed that these new rules are now in force. The new edition of the code embodying the revisions is now being prepared and will be printed and made ready for distribution as soon as possible. We cannot say exactly when it will be issued.

Meanwhile we believe it will be the practice of most, if not all, inspection departments to be guided by the 1920 rules. Each inspection department, whether of underwriters or of municipalities, will after the 1923 edition is issued decide for itself on what date it will begin to operate under the new code. The electrical committee of the National Fire Protection Association, which prepares the code, assumes no responsibility for determining when the new rules shall be actually made effective by inspection authorities. We believe that confusion and misunderstandings will be avoided if all who are interested in this subject will proceed on the basis that the 1920 code is still in effect and will continue so to do until the 1923 edition is issued.

DANA PIERCE,
Chairman Electrical Committee.
National Board of Fire Underwriters,
New York, N. Y.

Importance of Underground-Distribution Engineering

To the Editors of the ELECTRICAL WORLD:

The concluding lines of your editorial in the March 17 issue headed "Engineers Must Have Time for Forethought and Retrospection," were of great interest to me. Many engineers seem to look upon underground distribution as a necessary evil and not as the vital nerve of a system. This attitude may be due in large measure to the lack of proper training and incentive. In far too many cases a young graduate on joining a company with underground distribution is satisfied to accept an office job in that department and is content to lay out the work from that angle, hardly realizing or caring for the difficulties which beset the "outside staff." This attitude is all wrong, and only through actual outside experience, attention to detail and real interest in the work will "distribution engineering" become recognized and so come into the place that should be its own.

In my opinion distribution engineers should be se-

lected from men with a liking for outdoor work. On graduation they should be placed on the field staff, starting in to supervise under skilled engineers small matters such as the laying out of manholes, ducts, racking, splicing, etc. The importance of supervision of splicing and the correct radius and manner of bending the cables must be firmly impressed upon them, as it is in this actual field work that the maintenance costs either rise or fall. Too often there seems to be a tendency to fit the job to the cable, not the cable to the job, with ultimately disastrous effects.

Too many young distribution engineers cannot seem to realize that a badly made joint may when it subsequently fails necessitate pulling out and scrapping two lengths of cable, nearly always difficult to use elsewhere. Properly engineered work, even though it entails high construction costs, ultimately pays by its immunity from breakdowns and loss of service. I should not advise any young engineer to take up distribution work unless he is heart and soul in his work; for it is in the detail of the actual field work that the success or failure of his system lies, and to gain the training he needs necessitates long hours, patience and a real love of his duties. Distribution engineering is not a "job"; it is a lifelong study, every day bringing up new problems with hardly two alike. W. E. BOYLE,

Engineer Transmission and Distribution Department.
United Electric Light & Power Company,
New York, N. Y.

Gasoline Trucks Heavier than "Electrics"

To the Editors of the ELECTRICAL WORLD:

When your excellent editorial entitled "Penalizing the Electric Truck," which appeared on page 377 of the Feb. 17 issue, was reprinted in the *Literary Digest* of March 24, my particular attention was drawn to this sentence: "Therefore, in spite of its greater gross weight per net ton carried, due, of course, to the weight of the storage battery, the 'electric' is far easier on roads than any other type of truck."

Unfortunately this statement conveys an erroneous impression, since it it not in accord with the facts in the case. I give the exact data:

	1-Ton	2-Ton	3½-Ton	5-Ton
C-T chassis only	2,400	4,000	5,000	6,500
C-T chassis with battery	3,248	5,740	7,172	9,134
C-T chassis with average-weight battery	3,867	6,000	7,525	9,445

The weights of a number of standard-make chassis as given in the annual statistical number of *Automotive Industries* for Feb. 22, 1923, are:

	1-Ton	2-Ton	3½-Ton	5-Ton
Kelley-Springfield	4,670	.....	7,730	8,400
Mack	.....	5,400	7,970	8,550
G.M.C.	3,250	5,300	7,945	8,645
Diamond T	.....	.....	7,250	8,790
Brockway	3,250	.....	7,075	9,215
Pierce-Arrow	.....	6,000	8,300	9,300
Garford	3,500	.....	.....	9,350
Sterling	.....	5,950	8,350	9,750

A comparison of the above figures shows clearly that there is not "greater gross weight per net ton carried," but in many instances the gross weight is lower than for gas trucks of the same capacity.

A feature that seems to be entirely overlooked in most motor-truck legislation is the fact that electric trucks are used almost exclusively for city transportation. With very few exceptions none of them go outside urban limits. Since none of these trucks are used on state highways, some special consideration should be shown the users in taxation, as motor registration fees are applied to the upkeep of roads on which electric trucks seldom if ever operate.

Speed is another factor that has a great effect on wear of roads. The speed of the electric truck is inherently controlled. It is not subject to the whim of the operator. As a result the wear and tear on streets and roads from the operation of electric trucks is very much less than from gasoline-propelled vehicles of equal gross weight. Moreover, as the weight increases the speed automatically decreases, this feature being due to the characteristics of the motor itself, which acts automatically to adapt the speed to local conditions. We thoroughly understand that there was not the slightest intention to be unfair to the electric truck, but that, on the other hand, your desire is to further its use and protect its interests. Therefore the above facts are brought to your attention. H. S. MEESE,

Commercial Truck Company, Transportation Consultant.
Philadelphia, Pa.

Calibrating Five Meters Simultaneously

To the Editors of the ELECTRICAL WORLD:

I note with considerable interest the article by R. S. Hinman in the Feb. 24 issue of the ELECTRICAL WORLD (page 458) describing a method for calibrating five meters simultaneously, with particular reference to the number of meters tested per day. There is no question that the method described is both an accurate and a rapid one. At the same time I do not believe it is possible to test and stock from one hundred to two hundred meters per day, as is there stated.

Testing a watt-hour meter consists not only in determining whether the number of revolutions of the meter is correct in a given interval of time for the energy passing through the meter, but also that the test constant, register gearing and dial constant bear the correct relation to each other to translate correctly those revolutions into kilowatt-hours as registered by the dial. Furthermore, the mechanical condition of the bearings and the register gearing and the clearance of the disk between the jaws of the magnet should be inspected carefully and readjusted if found necessary.

Even new meters from the manufacturer are sometimes received with a wrong register ratio or constant, resulting in incorrect billing. The bearings may become damaged in transit or some of the parts get out of alignment. The point I wish to emphasize, therefore, is that it is not sufficient simply to test the accuracy of the meter without taking its mechanical condition into consideration. This cannot be properly done at the rate mentioned by Mr. Hinman.

C. H. INGALLS,

Edison Electric Illuminating Company, Meter Engineer.
Boston, Mass.

To the Editors of the ELECTRICAL WORLD:

In regard to the letter from C. H. Ingalls of which you sent me a copy I may say that we have been able to average 120 meters a day with new meters. This includes cleaning with compressed air, cleaning between disk and magnets, checking dial and disk constants, and test. We have tried also the method of checking one meter at a time. I am very much in favor of the present method. R. S. HINMAN,

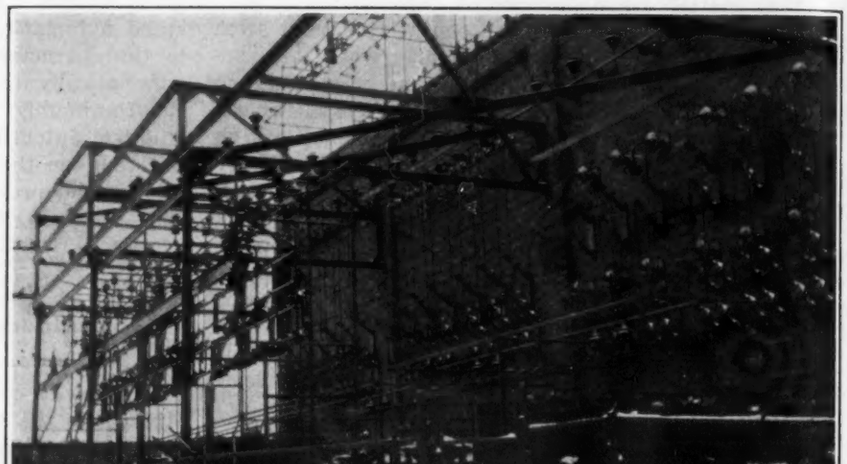
United Illuminating Company, Meter Department.
New Haven, Conn.

Central Station and Industrial Practice

Installation, Operation, Maintenance, Test and Repair of Generation and Distribution Equipment, and Methods of Economically Utilizing Electric Service in Large Industrial Plants

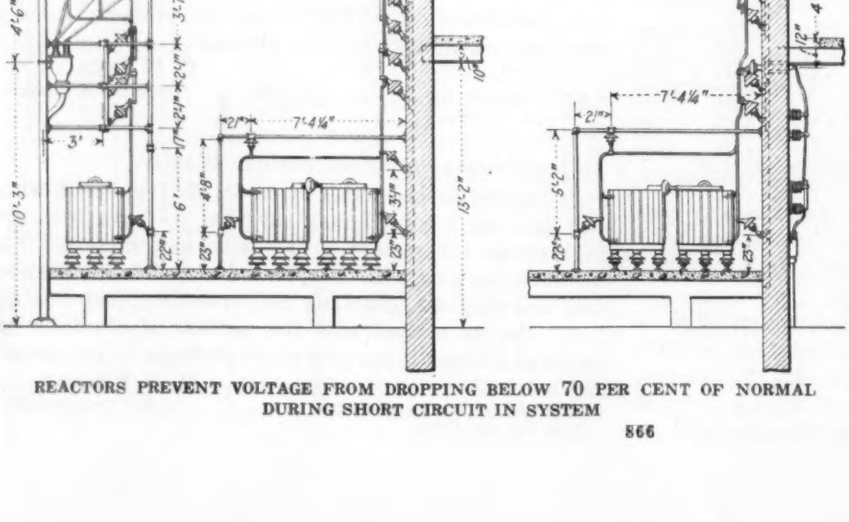
Installing Twenty-seven Reactors for $20,177

THE continued increase in generating capacity of the Central Illinois Light Company's main station at Peoria, Ill., required a corresponding additional increase in protective devices. The choice in giving this protection lay between installing higher-capacity circuit breakers and installing current-limiting reactors. Since the space required for breakers of the larger rupturing capacity was not available, nine three-phase sets of outdoor reactors were installed. Eight of these sets, with a rating of 200 amp. at 13,200 volts, were placed in circuits feeding various mine and mill loads. These reactors have a reactance of 2.76 per cent at 4,600 kva. load. The other set, standing 62 in. high, has a higher rating of 300 amp. at 13,200 volts and supplies service to the Keystone Steel & Wire Company of South Bartonville, a suburb south of Peoria. This unit has a reactance of 4.32 per cent at 7,200 kva. The total cost of the entire installation was $20,177.88.



OUTDOOR REACTORS MOUNTED ADJACENT TO SWITCHES WITH FACILITIES FOR SHUNTING OUT OF SERVICE

Not having space within either the generating station or the substation to install these reactors, it was necessary to place them outdoors between these two buildings, as shown in the photograph. Since this space also served as a driveway, it was not feasible to use any more of the space than necessary without restricting the entrance to the rear of the plant. Therefore a concrete platform, 56 ft. x 17½ ft., was erected 2½ ft. above the ground directly next to the substation wall. On this wall were placed the air-break switches in direct line with the reactors themselves. The steel superstructure afforded supporting means for the bus work on the outer row of reactors, besides allowing the top of the structure to serve as an insulator base for the distribution circuits. The circuits to the left of the reactors in the diagram come direct from the Liberty Street generating station through underground ducts. After passing through the reactors, these circuits continue through 3½-in. conduit embedded in the ground beneath the platform to the substations served by these feeders. Switching controls are so arranged that these reactors can be shunted out of the circuit without service interruption, thereby giving continuity should trouble arise on these reactors.



REACTORS PREVENT VOLTAGE FROM DROPPING BELOW 70 PER CENT OF NORMAL DURING SHORT CIRCUIT IN SYSTEM

Before these reactors were installed the main bus voltage would sometimes drop to zero when a short circuit occurred on one of these 13,200-volt feeders. This would also cause a general disturbance all over

the system and at times create a complete shut-down due to generators falling out of step. Since installing these reactors several short circuits have occurred, but at no time has the main bus voltage fallen more than 30 per cent below normal. The percentage reactance is calculated to maintain 50 per cent of normal bus voltage when a short-circuit occurs just beyond the reactors or right at the main station without any line in the circuit.

C. R. BUSH,
Electrical Engineer.
Central Illinois Light Company,
Peoria, Ill.

Divided Opinion on Value of Flexible Couplings

THE application and operation of flexible couplings were discussed at a recent section meeting of the Association of Iron and Steel Electrical Engineers held in Pittsburgh. Both operating men and representatives of manufacturers told of the strong and weak points in various coupling designs. Perhaps the most important facts brought out were that the couplings should be properly installed with as little misalignment as possible, that they should be checked at intervals to make sure that misalignment has not become excessive, and that the couplings should be kept thoroughly lubricated. The difference between the elastic type of coupling and the coupling which only transmits power from one shaft to another without any elasticity was dwelt upon. There was some difference of opinion as to the need for elasticity to prevent transmitting shocks from the driven machinery to the driving equipment and vice versa. Two representatives of motor manufacturers claimed that an elastic connection was necessary. On the other hand, two operators and one coupling manufacturer said that they had found no shock absorber necessary.

It was stated by some of the operating men that end thrust, sometimes of an excessive amount, was present with practically all types of couplings. Ample lubrication, they held, is the only means of reducing this to reasonable limits.

The effect of synchronous vibrations in producing very wide oscillations was discussed. It was shown that if ordinary steel springs are used in the couplings oscillations of a certain frequency may start mechanical surges which may eventually do much damage. These oscillations may be damped out by friction or by the use of elastic materials like rubber and leather in place of steel springs. It was also pointed out that if necessary the springs could be made with a varying modulus of elasticity so that they would not have any definite oscillating period. One speaker asserted that if the vibration periods of the machinery were studied a spring might be chosen with another period and this would eliminate surges.

FIELD EDITOR ELECTRICAL WORLD.
New York, N. Y.

Extracts from an Operating Code

BY FIELD EDITOR ELECTRICAL WORLD
New York, N. Y.

Starting Motor-Generators from the D. C. Side

THE most important point in starting an induction motor-generator from the direct-current side is to have the field of the generator properly excited at the start. Should the field current be open or should too much resistance be cut in the field circuit, the machine may not turn over, or, should it start, its speed would increase to a dangerous value. Full field strength gives maximum starting torque and minimum running speed. During starting the generator has its field connected to the bus, but when running it should be connected across the brushes to insure safety of operation, as a loss of field might occur under separate excitation and cause the machine to race. The following rules for starting synchronous or induction motor-generators from the direct-current side have been abstracted from the operating code of the Philadelphia Electric Company:

STARTING

1. Where an oil pump is provided, start it. Adjust the valves on the pipes feeding the bearings so that the one farthest from the pump will be open widest. If this does not lift the shaft from the bearing, open one valve wide at a time until the shaft does lift. Then adjust the valves as stated above. It is necessary on some machines which are hard to start to assist the starting by hand with a ratchet and bar.

2. Make sure that the generator field rheostat is all out.

3. Test the generator field switch for voltage, and if there is no evidence of any, throw the switch to the bus side.

4. Close the direct-current circuit breakers.

5. Close the machine selector and starting resistance selector switches; then place the starting switch on the first point.

6. If the starting resistance is connected to the positive bus, close the positive machine switch.

7. Cut out the starting resistance, pausing between steps to allow the armature current to decrease to a low value, and when the last point is reached close the negative (or positive) switch. (Note.—In some cases it may be found that the acceleration is too violent and the current excessive in passing from one resistance step to the next. In these cases increase the speed on each starting point to approximately that of the next point by weakening the field. Then, simultaneously, bring the field up to full strength and pass to the next starting point.)

8. Test the field switch and, if no difference in potential between the two contacts is noted, throw the field switch to the machine side. Restore the machine selector and starting selector switches to normal positions.

9. Bring the machine up to speed by cutting the field rheostat in, synchonize and close the machine oil switch. (Note.—If the motor is a synchronous motor, close the motor field switch, adjust its voltage to that of the bus and synchronize.

10. Load the generator.

SHUTTING DOWN

1. Reduce the load on the machine to be taken off as much as possible.

2. Trip the circuit breaker and open the machine and equalizer switches.

3. Open the alternating-current bus switch.

4. In the case of a synchronous motor, cut all resistance in the field and open the field switch.

Instructions for Banking Boilers

IN GENERAL, boilers should not be banked until the load on every boiler in service falls below normal rating. As all coal burned during the banking is a loss, every effort should be made to reduce the draft through the fire bed and setting to a minimum. During the banking period stokers should be turned over occasionally to prevent the fire bed from becoming too porous or honeycombed. These rules form part of the operating code of the Philadelphia Electric Company, from which the following instructions for banking boilers are abstracted:

1. Cut off the forced draft.

2. Stop both the induced and forced draft fans.

3. Cut off the stokers. In case of light fire at the time of banking, let the stoker turn about three revolutions to give a bed of green coal and repeat this operation approximately every hour during the banking period.

4. Close the damper of the stack draft until the opening is just sufficient to clear the furnace of gases.

5. Close the main feed-water valve to the boiler.

Most Economical Power Factor

Must Be Considered from Standpoint of Investment in Apparatus—Use of Synchronous Condensers and Unity-Power-Factor Motors Analyzed

THAT 100 per cent may not be the most efficient power factor for a commercial installation was shown in a recent paper presented before the Power Sales Bureau of the New England Division, N. E. L. A., by A. R. Stevenson, Jr., of the power and mining engineering department, General Electric Company. The speaker analyzed a system where the power company installed a synchronous condenser near the load center. The question arose as to what power factor is the most economical. The answer was a compromise between the determination of the most efficient power factor and the best power factor from the standpoint of investment in apparatus.

Considering the addition of synchronous condensers to a power system for the purpose of raising the power factor, the most efficient power factor, said the speaker, will be given by the formula:

$$\text{Power factor} = 1/\sqrt{1+(c/a)^2}, \quad (1)$$

where c represents the losses of the synchronous condensers, excluding the excitation loss expressed as a fraction of the kva. rating of the synchronous condenser (do not include the excitation loss of the synchronous condenser because the ampere-turns excitation furnished in the synchronous condenser balances other ampere-turns which would have been necessary in the generators and it simplifies the problem to assume that these balance exactly), and a is the total resistance loss at unity power factor and given load in the alternators, transformers and distribution system expressed as a fraction of the load in kw.

The losses of a 300-kva. synchronous condenser are 21 kw., but 5.5 kw. of this is the excitation. Therefore $c = 15.5/300$, or approximately 0.05.

The losses in the alternators, transformers and transmission lines are between 10 per cent and 15 per cent. By substitution in equation (1), the most efficient power factor for these two losses will be 89 per cent and 95 per cent respectively.

From the standpoint of lowest first cost the best power factor is given by the formula:

$$\text{Power factor} = 1/(1+b^2), \quad (2)$$

where

$$b = m/(n+p), \quad (3)$$

m = the price per kva. of the synchronous condenser,

n = the price per kva. of the generating plant,

p = the price per kva. of the distribution system.

A 2,500-kva. turbo-driven generator costs about $5.20 per kva. If the turbine is included, the price is about $14. It is likely that if a customer buys a larger generator he will also buy a larger turbine. Consequently let $n = \$14$. It is also likely, the speaker said, that the distribution system would cost at least $20* per kva. Therefore let $p = \$20$. Substituting these values in equation (3), $b = 0.325$. The best power factor from the standpoint of the first cost can be obtained by substituting this value of b in equation (2). The power factor will be 91 per cent.

It is therefore advisable to raise the power factor to approximately 90 per cent from the standpoint of most efficient operation and that from the standpoint of lowest first cost the power factor should be somewhere in the neighborhood of 91 per cent.

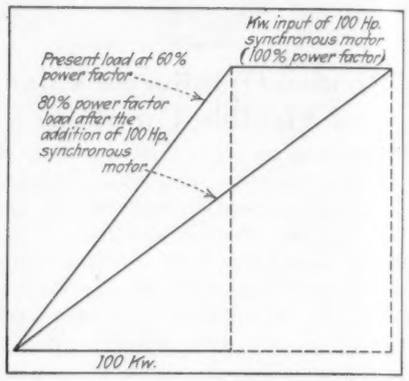

Kw. input of 100 Hp. synchronous motor (100% power factor)
Present load at 60% power factor
80% power factor load after the addition of 100 Hp. synchronous motor
100 Kw.

FIG. 2—POWER FACTOR OF SYSTEM IMPROVED BY ADDING UNITY-POWER-FACTOR SYNCHRONOUS MOTOR TO SYSTEM

While the losses of a 300-kva. synchronous condenser are about 21 kw., the losses of a 300-kva. static condenser are only about 1½ kw., but a static condenser of this size costs about 60 per cent more than the synchronous condenser. Static condensers need maintenance and should be installed and kept up by the power company.

When the synchronous condenser belongs to a customer the question cannot be solved in this way. The advantage derived by the customer in installing the synchronous condenser depends entirely on the bonus for power-factor correction given by the power company. This bonus must be compared with the fixed charges on the investment and the energy loss in the condenser which the customer has to pay for in his monthly power bill. The speaker knew of only about seventeen power com-

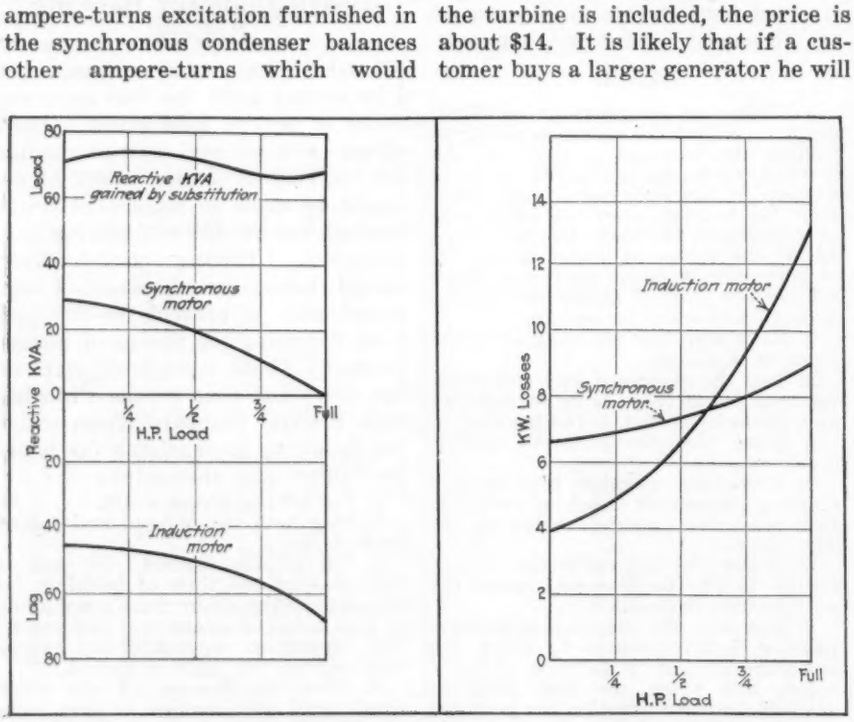


FIG. 1—COMPARATIVE CHARACTERISTICS OF UNITY-POWER-FACTOR SYNCHRONOUS MOTOR AND SQUIRREL-CAGE INDUCTION MOTOR

*The $20 per kva. is not taken here as the total cost per kva. of the distribution system. It is the cost per kva. of increasing the capacity of the system and merely represents the cost of the copper required for a medium-sized system. The cost of increasing the capacity of the transformer banks should be included in any particular cost.

panies in the country which give bonuses for power-factor correction.

Unity-power-factor synchronous motors can be built for very little more than the cost of a slip-ring induction motor and have as good or better efficiencies. At low speeds the comparison is all in favor of the unity-power-factor synchronous motor as against an induction motor.

At the same time, a unity-factor synchronous motor will improve the customer's power factor, such a type of motor having been recently developed. The expense of installing these motors has been reduced to a minimum by simplifying the control. The exciters are adjusted for unity power factor at full load, and no field rheostats are necessary. The only control apparatus needed consists of a standard starting compensator and a standard field switch. The motors themselves being designed for unity power factor, they have good efficiency, and their prices are only slightly more than those of slip-ring induction motors.

The power factor can be improved considerably by adding a unity-power-factor synchronous motor as shown in Fig. 2. This figure represents a load of 100 kw. at 60 per cent power factor, to which is added a 100-hp. unity-power-factor synchronous motor. The result is approximately 180 kw. at 80 per cent power factor.

But if the alternative of installing an induction motor is considered, the improvement in power factor obtained by putting in a unity-power-factor synchronous motor is even more apparent because of the lagging kva. of the induction-motor alternative. Fig. 1 shows the comparative characteristics of a 150-hp. unity-power-factor, 720-r.p.m., 2,200-volt synchronous motor and a 150-hp. 720-r.p.m., 2,200-volt squarrel-cage induction motor. It will be noticed that with the field set at its full-load value the synchronous motor draws some leading kva. at part loads. The removal of the induction motor reduces the reactive lagging kva. The total improvement of the system obtained by replacing the induction motor with a unity-power-factor synchronous motor is the sum of the reactive kva. lagging of the induction motor and the reactive kva. leading of the synchronous motor. The change is therefore equivalent to adding a 70-kva. condenser. At full load the efficiency of the synchronous motor is better than that of the induction motor, but with full-load field setting the no-load losses are greater. However, even at no load these losses are only 2½ kw. more.

By this substitute there is gained the equivalent of a 70-kva. condenser with less than 2½ kw. losses. A 70-kva. synchronous condenser would have about 6½ kw. loss.

It is thus seen that when a customer wants to improve power factor it is sometimes more advantageous to replace an induction motor by a unity-power-factor synchronous motor than to purchase a synchronous condenser.

FIELD EDITOR ELECTRICAL WORLD.
Boston, Mass.

Rugged Meter Case May Be Used as a Stool

THE combination meter tester's instrument and tool case shown in the accompanying illustrations was designed and built with the object of having everything in place so that tools, leads, etc., could be got at quickly and a meter tested in the minimum time. The case is strong enough to stand on when the meter cannot be reached from the floor, and in many cases this saves the time of hunting up a box or chair. The outside dimensions of the case are: Height, 17½ in.; length, 12½ in.; width, 9½ in. The testing apparatus carried consists of a test rheostat with a capacity of 0.5 amp to 15 amp. and a rotating standard meter with a rating of 1 amp. to 20 amp. Two compartments with a cover in the lid of the case are used for leads, jumpers, lamp socket and cord. Inside the case on the left side are pockets for meter seals, dust brush, slide rule and meter-test kit. In the bottom is a box 7 in. x 9 in. x 2 in. deep, with cover, which is used for extra fuse plugs, jewels and meter repair parts. The case with instruments and tools weighs 40 lb.

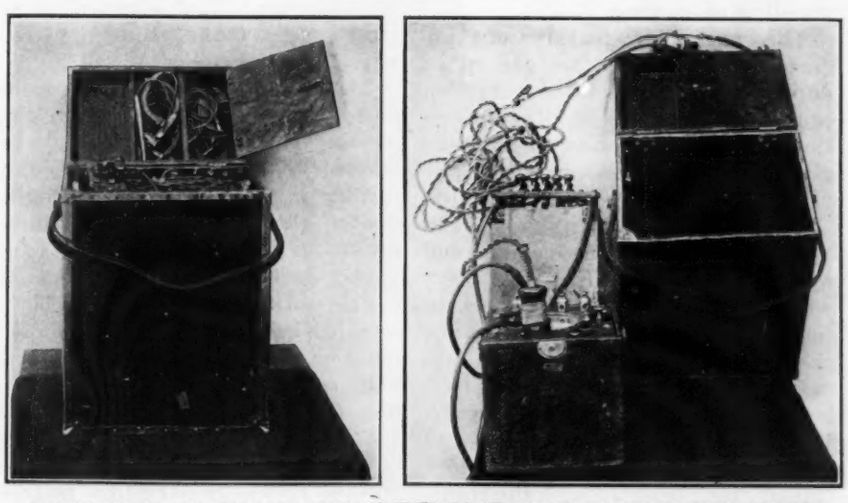
HALLETT B. GRAEFF.
Los Angeles Gas & Electric Corporation, Los Angeles, Cal.

Handling Ice Troubles in Hydro Plants*

THE most important trouble to guard against in the design and operation of hydro plants is caused by ice. The ice is of three kinds—"local" ice (that is, cake ice that has been formed in the forebay or in the canals leading to the plant), up-river ice, which moves down from the creeks and tributaries into the main river and eventually will pass by the plant, and frazil and anchor ice. The first kind can be released through ice chutes or by removing the most troublesome pieces with the hoisting facilities of the gatehouse; very little of the second kind enters the forebay of a modern plant, and it may be regarded as harmless so far as interruptions to service are concerned. The third kind, however—frazil or anchor ice—although it creeps along stealthily and without spectacular accompaniments, is most dangerous. Some remedies can be provided in the design of the plant and equipment, but the most reliable protection lies in a systematic procedure for detecting the approaching danger well in advance and mitigating its disturbing effect by a well-organized system of protection.

There are many possible ways to diagnose impending frazil-ice runs,

*Abstract from address before a joint meeting of the A. I. E. E., A. S. M. E., A. S. C. E. and A. I. M. M. E. at New York, March 21, 1923.



WHEN LID IS CLOSED CASE MAY BE USED TO STAND ON TO REACH HIGH METERS

beginning with the study of climatological conditions, accurate readings of water temperatures, inspection of submerged test chains or other metal objects, observation of the behavior of small waterwheel-driven auxiliaries that operate acoustic or optic signaling devices, etc. The remedial steps consist in the raising of the screens, maintaining of highest possible temperature in gatehouse and power house, continuous movement of guide-vane mechanism, steam or electric heating of those submerged metal parts where the ice is inclined to stick, etc. Electric heating may be used directly on the screens, or it may be applied indirectly by circulating air through heating chambers containing electric heaters.

The most simple and effective heating method consists in the use of a boiler that supplies a small header with steam which taps into each wheel casing. The steam is turned on alternately from one pit to the other, taking one unit out of service at a time. The steam does not actually melt the ice, but after a few minutes' application the ice coating loses its adhesive force, and when the water is turned on again the ice drops off and is washed out into the tailrace.

F. A. ALLNER,
General Superintendent.
Pennsylvania Water & Power Company,
Baltimore, Md.

"Wired Wireless" for Communication with Line Crews

EXPERIMENTS indicating the practicability of using high-frequency current for communicating with trouble wagons and line crews were conducted on March 26 by the Third Avenue Railway, New York, in conjunction with the General Electric Company. Although these particular experiments were conducted for application to electric railways, similar circuits may possibly be applied to central-station companies for communication between generating stations, substations, line crews and patrol wagons.

A laboratory set-up of a radio transmitting and radio receiving set was installed on a street car, with corresponding apparatus in a substation which supplied energy to the line over which this car was operated. Perfectly audible communication was conducted between the car and the substation from various points on the line, with the car either standing or moving.

The particular feature of this demonstration was the use of a duplex current whereby conversation could be carried on in either direction, just as it is done over the telephone. This was accomplished by utilizing two different frequencies. The transmitting set at one end and the receiving set at the opposite end were tuned for a frequency of 73,000, while the other pair of sets were tuned for 49,000 cycles. Currents of the two frequencies were thus conducted over the same wires, the trolley and feeder, without interference. By putting on the head telephones of the receiving set and talking into a transmitter connected with the transmitting set, it was possible to receive and transmit without the use of any changeover switch.

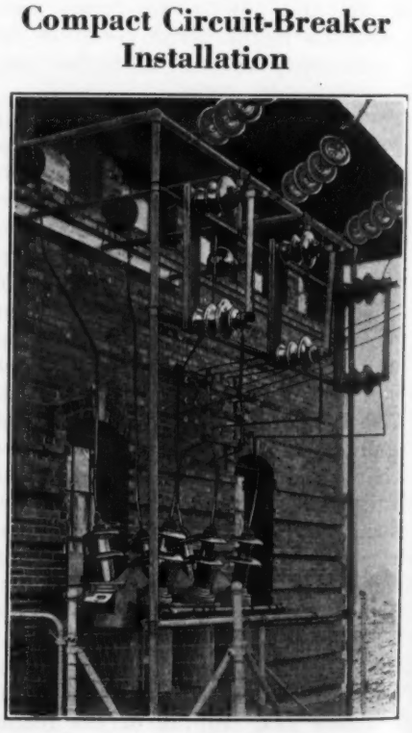
The set-up in the street car consisted of an ordinary simple radio receiving set with one three-electrode vacuum tube connected as a detector and another as an amplifier. The transmitting set made use of three type UV 203 tubes of 50 watts capacity. These three tubes were used as an audio-frequency amplifier, an oscillator and a modulator. The power for the sending set was supplied by a 1,000-volt motor-generator set with the energy to operate it supplied by twelve cells of storage battery supplying approximately 24 volts. A similar set-up was used in the substation, except that in the receiving set only a single tube was used as detector and amplifier. In the substation the sets were connected to the outgoing feeder through a condenser of low voltage drop. A condenser was, of course, also inserted in the circuit between the set on the car and the main power-feed wire from the trolley.

The General Electric Company had been engaged in experimental work on the Third Avenue Railway for several weeks to determine the constants of such a system, looking toward the development of suitable apparatus for utilizing high-frequency carrier current for communication work. While it is possible to establish communication between any point on the system and any car suitably equipped with apparatus, the idea will be primarily to devise plans for communication between some central emergency office and line and trouble crews, construction and repair gangs, and, perhaps, such transportation men as starters and inspectors out on the system. The principal advantage of the wired wireless as compared with radio communication is that it requires much less input of power, and that, while the current probably spreads over the entire overhead and feeder system, the radiation into the ether is very small so that it introduces practically no interference with any radio communication. It would therefore not be necessary for a railway company to have a government permit for a radio sending station in order to use its own system for wired-wireless communication.

The demonstration on the Third Avenue Railway was conducted in the presence of an invited group, including representatives of the General Electric Company, the American Telephone & Telegraph Company, the Radio Corporation of America, the Electric Storage Battery Company, the ELECTRICAL WORLD, local newspaper men and officials of the Third Avenue Railway. The test was in charge of Walter J. Quinn, electrical engineer of the railway company, and Edward Austin of the General Electric Company.

FIELD EDITOR ELECTRICAL WORLD.
New York, N. Y.

Compact Circuit-Breaker Installation



THE above illustration shows a 44,000-volt circuit breaker mounted on pipe frame in an inclosure protected by wire fencing. Entering and exit leads are protected from direct downpour of rain by the extended roof shown.

Central Station Business

Advertising, Selling and Service Methods
Commercial Organization and Management, Customer and Trade Relations, Public and Financial Policies, and Reports of Company Plans and Experiences

Connecting Service in 2 Hours 48 Minutes

How the Syracuse Lighting Company Takes Applications, Passes Credits and Gives Service in Less than Three Hours' Average Time

NOTHING a central-station company can do will earn greater appreciation from a customer than quick action in connecting up his service after the application has been made. With the object of reducing to a minimum the elapsed time between the signing of the application and the cutting in of the service, the Syracuse (N. Y.) Lighting Company has adopted a method of dispatching and executing "connect-up" orders which has virtually eliminated all lost motion. It has brought the average elapsed time per order down to two hours and forty-eight minutes and has made many solid friends for the company. Such a record is particularly noteworthy when it is considered that in many well-operated utilities at least a half a day is required for the necessary office routine of approving credit, making out the order and sending it to the meter department for execution. This particular part of the operation is accomplished by the Syracuse company in just two minutes.

The service has grown out and is a part of Manager G. I. Vincent's conception of his company as a personality represented to the customer by the individual employee. In the practical application of the idea he has been assisted by Ernest Johnston, auditor, and the hearty co-operation of the entire personnel of the company. To get the proper background for the method by which these results are accomplished it is necessary first to know how Mr. Vincent visualizes his company and then hear Mr. Johnston's story of carrying out the plan. The whole idea is based upon a "Bill Jones" service which Mr. Vincent describes as follows:

Foundation of the Service

"Once upon a time there was a little gas and electric company in a tiny village. The manager's name was unimportant, so we will call it 'Bill Jones.' Bill had two or three assistants, all told, and was the alternate for all of them. He knew everybody in town by his first name and everybody knew Bill. They were all good friends. Bill never had any trouble that he could not readily adjust and the flannel-mouthed demagogue would never have made a good start. If he tried to run down Bill or his little company, he would have been run out of town, because the folks knew Bill personally and knew he was a regular fellow besides knowing his business.

"Now, imagine the lapse of many years and that the tiny town has grown to a metropolis. With it grew its public utilities, and apparently their efficiency in operation improved, because the management was progressive, kept pace with the times, and developed high-grade men and women, trained to do their particular task in a highly efficient way. Bill Jones has long since passed on and who has taken his place? Nobody. The utility has changed from a personality to a thing. The high specialization carried with it essentially a cold-blooded adherence to routine. The customers found their

FIG. 1
WHERE THE CUSTOMER ORDERS SERVICE

Showing an interpreter at the office taking application for service from a foreign-born resident who cannot speak English and transmitting it on the telautograph to the credit and shop departments. These instruments are shown mounted upon a temporary counter while moving the company's office to a new location.

FIG. 2
CREDIT DEPARTMENT LOOKS UP RATING

Employees examining records to clear credits on applications taken as shown in Fig. 1, which records on instruments at main office and shop.

FIG. 3
METER SHOP MAKES OUT "TURN-ON" ORDER

The operator at the shop makes up orders, which are transmitted by telautograph after credit has been passed. There is also shown on the right the telephone order table at which applications for gas and electric service and for complaints and notices of a leak are taken and are given direct to "Bill Jones."

requests attended to at length by a hopeless succession of workmen in their homes. True, each task might have been well done and each request in the office courteously answered, but the customer was dazed by the multiplicity of contacts, and there was confirmed in his mind the soapbox utterances that he had heard so often—that the utility was a cold-blooded, heartless corporation. The personal element was gone.

"The 'Bill Jones' idea of the Syracuse company is a sincere attempt to do in the large utility what 'Bill Jones' did in the tiny one.

"Essentially, the order-taking and order-executing departments had to be reorganized in a most revolutionary way, but that is not by any means the whole story. The idea is that each employee in coming into contact with our customers should imagine himself the 'Bill Jones' whose effort was to give the perfect and complete service and leave the customer a friend."

Such is the principle upon which the Syracuse Lighting Company is rendering a superservice and is cashing therefrom large dividends in customer friendship and good will. How it is done, from taking the customer's application to turning on the service, Mr. Johnston tells in an equally entertaining and logical manner.

How the Plan Operates

"'Maka lights burn my house, please,' says a swarthy-looking woman to the clerk at the order counter. A crude and simple sentence, yet one which is capable of setting in motion the machinery which executes the order of furnishing gas and electric service to about 200,000 inhabitants of the city of Syracuse.

"Miss Smith, an efficient clerk, trained and advised by men who have studied carefully the situation and evolved through experience and judgment a system most satisfying to the customer, picks up her pen and commences the execution of the order.

"There are three divisions on the pad of orange-colored paper on which the application is written. The first division is the original application known as a 'turn on' and contains the date, name, address and kind of service desired, as well as the customer's signature. This may be accepted over the telephone in cases where the credit is satisfactory as readily as though the customer called at the office. When this application for service is accepted, the customer is informed that some one must be at home when the service is turned on. This is necessary in order to have the formal application signed if the request for service has been made by telephone. In case of a new customer where a deposit is required arrangements must be made through the collection department.

"The second division contains the name, address, occupation, kind of service desired and the address from which the customer is moving. This part of the application is filed according to the street and is used to follow up the completion of the work. The third division is familiarly known as a 'shut-off' notice and contains the name, address, floor, date notice is taken and date of discontinuance. The address to which the applicant is moving is also necessary so that the final bill may be forwarded to him. The 'shut-off' notice is also signed except in cases where it is accepted over the telephone.

"When these blanks are properly filled in, the order is ready to be conveyed to the various departments concerned. The vehicle of transportation is the telautograph, which makes an instantaneous record of communication between the order department, the credit and collection department and the gas-meter shop. In cases of special electric service this information is conveyed from the gas-meter shop to the electric shop by a separate instrument.

"Let us put ourselves in three places at once. The clerk in the order department writes the application on the telautograph in the manner shown in Fig. 1. This produces a visible record in three places, namely, the order department, the credit and collection department and the gas-meter shop. The credit and

RECORD OF SHOP ORDERS

Transmitted by the telautograph Jan. 8, 1923, to show time between actual receipt of order and execution of same. This does not include notices of leak and miscellaneous orders received by telephone at shop. The record of only one machine is given. The total for the day is shown in the summary.

Telautograph Nos.	Nature of Order	TIME: Application Made by Consumer	Credit Passed	Further Credit Investigation	Order Given to "Bill Jones"	"Bill Jones" Arrived at Premises	Elapsed Between Hr.	Elapsed Between Min.	Remarks
"A" Machine									
1	Special test	8.49	....	....	.....	.....	..	..	To be done 1-9-23
2	G.	9.20	9.21	....	.....	.....	..	..	Bookkeeper only
3	G.	9.47	9.48	9.57	11.08	11.15	1	28	
4	Canceled								
5	Sales	10.00	10.39	....	12.00	1.35	3	35	Welsbach heater
6	E.	10.14	10.15	....	12.00	1.00	2	46	
7	P.S.	10.17	.....	....	11.21	1.35	3	18	C.G.I.
8	Set G. & E.	10.18	10.19	....	12.00	5.05	6	47	
9	S. G. & E.	10.19	.....	....	12.00	.....	..	..	To be done 1-15-23
10	Void								
11	G. & E.	10.25	10.26	....	.....	.....	..	..	To be done 1-20-23
12	S. T.	10.30	.....	....	.....	.....	..	..	To be done 1-9-23
13	C. & E.	11.00	11.01	....	12.00	1.30	2	30	
14	Special Electric								
15	E.	11.15	11.16	....	.....	.....	..	..	To be done 2-20-23
16	P. S.	11.18	.....	....	12.00	1.50	2	32	
17	Complaint	11.20	.....	....	12.00	4.00	4	40	
18	P. S.	11.20	.....	....	12.00	5.20	6	00	
19	S. T.	11.21	.....	....	.....	.....	..	..	To be done 1-9-23
20	S. T.	11.38	.....	....	.....	.....	..	..	To be done 1-9-23
21	G. & E.	11.37	.....	....	11.40	.....	..	..	To be done 1-10-23
22	G. & E.	11.40	11.41	....	12.00	1.45	2	05	
23	S. G. & E.	11.42	.....	....	.....	.....	..	..	To be done 1-10-23
24	S. G. & E.	11.45	.....	....	12.00	3.00	3	15	
25	G. & E.	12.02	12.03	....	12.10	2.05	2	03	
26	Special Electric								
27	Set G.	12.19	12.20	....	2.42	4.00	3	41	
28	Set G.	12.30	12.31	....	12.40	4.20	4	00	C. G. I.
29	G. & E.	12.34	12.35	....	2.42	2.50	2	16	
30	P. S.	12.40	.....	....	6.15	8.15	7	35	Wrong address
31	P. S.	12.40	.....	....	3.00	3.40	3	00	
32	A. R.	12.45	.....	....	.....	.....	..	..	To be done 1-9-23
33	A. R.	12.47	.....	....	12.50	3.20	2	33	
34	P. S.	12.48	.....	....	.....	.....	..	..	To be done 1-9-23
35	S. G.	12.50	.....	....	2.42	.....	..	..	To be done 1-15-23
36	G. & E.	12.56	12.56	....	.....	.....	..	..	To be done 1-10-23
37	S. T.	1.00	.....	....	.....	.....	..	..	To be done 1-9-23
38	Leak	1.40	.....	....	1.50	2.30	..	50	
39	A. R.	1.46	.....	....	.....	.....	..	..	To be done 1-9-23
40	G. & E.	1.53	1.54	2.06	.....	.....	..	..	Bookkeeper only
41	G. & E.	2.06	2.07	....	3.27	4.15	2	09	
42	Special Electric								
43	G.	2.46	2.47	....	4.14	5.00	2	14	
44	R. S.	2.50	.....	....	3.48	5.20	2	30	
45	S. T.	5.10	.....	....	.....	.....	..	..	To be done 1-9-23
46	S. T.	5.11	.....	....	.....	.....	..	..	To be done 1-9-23

Code:—S. T. Special test.
G. Turn on gas.
E. Turn on electricity.
G. & E. Turn on gas and electricity.
P. S. Poor supply.
S. G. & E. Shut off gas and electricity
A. R. Adjust range.
C. G. I. Can't get in.

SUMMARY

Total number of orders	141
Orders completed 1-8-23	68
Total time	190 hr. 48 min.
Average time per order	2 hr. 48 min.
C. G. I's	17

collection department reads this record and immediately looks up the credit rating (Fig. 2). At the same time the operator at the shop is making a copy of the order (Fig. 3). It is now the collection department's move, and it shows by means of a code symbol written on its machine whether the credit is O. K. or if a deposit is required.

"At this point, in order to speed up the passing of credits, it was necessary to revise the method of keeping these records as the company has on its books approximately 80,000 gas and electric accounts. Accordingly, a card index was made of all accounts on which a deposit would be required or the credit was doubtful. This file of dubious accounts numbers about 5,000, so that the credit department in looking up the rating of an applicant simply consults these cards and if the customer's name is *not* found the credit is approved at once. From this it should not be assumed that the company has 5,000 bad accounts, for the index includes the names of many people who have moved out of the city or whose accounts for some reason have become inactive.

"Any information that any one of the three places concerned desires can, of course, be obtained by writing on the machines, which will reproduce a record in the same manner as above described. A typical telautographed order is shown in Fig. 4.

"When the credit has been properly established, the order is given to 'Bill Jones' to execute. We usually associate the name of 'Bill Jones' as that belonging to the eighteen men whose duty it is to fill these orders of 'turn on' and 'shut off,' as well as those dealing with complaints, etc. However, all employees coming in contact with the public consider themselves individually as 'Bill Jones.' That is, they are to feel personally interested in each case coming to their attention and do all they can to see that the customer is properly satisfied. The speed with which the orders are carried out can best be illustrated by a story which these men tell.

"Mrs. J—— of Tompkins Street came into the office of the Syracuse Lighting Company on Tuesday morning at 10:15 o'clock and made application for gas and electric service at her home. The clerk took her application and completed all arrangements with the parties concerned. At 10:17 Mrs. J—— left the office. She boarded a street car and upon arriving at her home at 10:40 met a man just leaving her house to enter a Ford roadster standing at the curb. She looked inquiringly at him, and he asked if she were Mrs. J——. When she answered in the affirmative, he said:

"'I'm from the Syracuse Lighting Company and am here to turn on your gas and electric meters.'

"'What!' said Mrs. J——. 'Why, I just signed for it.'

"'Bill Jones' grinned: 'I'll say that's service.'

"Most gas and electric companies agree that if an order is executed in from one to three days after its receipt it is good work. We are doing it in less than three hours.

"Statistics are always convincing, and we therefore use this method to

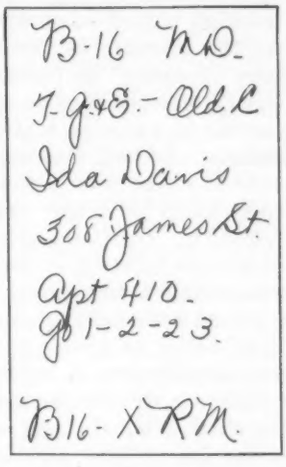


FIG. 4—TELAUTOGRAPHED SHOP ORDER

back up the statement that we found it possible by means of the telautograph instrument and the 'Bill Jones' organization to reduce the time from days to hours. A record was kept by placing the time of receipt on each application written on the telautograph and having 'Bill Jones' note on his order the time it was completed.

"What was the result? The average time required to secure gas and electric service was not two or three days, but two hours and forty-eight minutes. In order that it may be understood just how this test was made, there is shown also a detailed analysis of some of the orders taken during the test.

"Cases are constantly coming up which show how well this system works. Take the case of Mr. B——, for instance. Mr. B——, a resident of another city, came into our office at 9:50 in the morning and wanted his gas and electricity turned on at 308 James Street.

"'Say, have it done as soon as you can, will you?' Mr. B—— said. 'I've got to take the wife and babies down to dinner today, and it's an awful nuisance getting them all dressed and lugging them back and forth on the street car.'

"'Will noon be all right, Mr. B——?' the clerk asked.

"'Noon? Sure! When?'

"'Why, today.'

"Mr. B—— smiled. 'Well, that's good news, if it's true,' he said and walked out of the office.

"At 11:15 Mrs. B—— called up the office to tell us that her service had been turned on and to thank us for the prompt and considerate treatment she had received. She even brought the baby to the telephone and let him say, 'Thank you.'

"This is an actual case taken from our records, but it is in no sense a test case. It is only one of thousands which the company handles each year in its effort to perform its work efficiently and in the shortest possible time."

Estimated Income from Appliance Sales at Providence

LAST year's sales of appliances in the electric shops of the Narragansett Electric Lighting Company, Providence, R. I., will add an estimated annual income from the use of electricity totaling $109,465. Through the courtesy of Arthur B. Lisle, general manager of the Narragansett company, the accompanying schedule of appliances sold, together

REVENUE FROM ENERGY CONSUMPTION OF APPLIANCES SOLD IN 1922

Appliances	No. Sold	Income per Appliance	Estimated Yearly Income
Fireless cookers	17	$6.00	$102.00
Chafing dishes	24	2.00	48.00
Hair dryers	28	3.00	84.00
Drills	10	6.00	60.00
Fans	332	2.00	664.00
Radiant stoves	55	3.60	198.00
Grills	360	6.00	216.00
Immersion heaters	144	3.00	432.00
Auto heaters	34	4.00	136.00
Water heaters (large)	18	96.00	1,728.00
Curling irons	386	3.00	115.80
Waffle irons	89	3.00	267.00
Ironers (electric)	7	36.00	252.00
Ironers (gas)	7	6.00	42.00
Flatirons	4,248	6.00	25,488.00
Tailors' irons	36	12.00	432.00
Sewing machines	31	2.40	74.40
Sew motors	162	3.60	583.20
Heat pads	342	3.00	1,026.00
Percolators	482	3.60	1,735.20
Radiators	1,117	6.00	6,702.00
Ranges	52	84.00	4,368.00
Pumps	191	6.00	1,146.00
Disk stoves	317	3.60	1,041.20
Toasters	1,280	3.60	4,608.00
Thermolites	24	3.00	72.00
Vacuum cleaners	2,214	3.60	7,970.40
Vibrators	227	3.00	681.00
Clothes washers	474	3.60	1,706.40
Dish washers	13	6.00	78.00
Portable lamps	4,768	6.00	28,608.00
Rectifiers	72	12.00	864.00
Total income			$109,465.80

with the estimated yearly income, is published.

A. H. Allcott is manager of electric shops, of which there are seven in the company's territory. While the company's merchandising operations are conducted to show a profit on sales sufficient to cover all expenses including overhead, the primary object is to increase the use of energy by residential customers. From the tabulation it will be noted that portable lamps and flatirons exceed all other single items, while vacuum cleaners are third.

Electric Range Demonstrated to Rotary Club

THE accompanying cut shows the members of the Rotary Club of Boulder, Col., as guests of C. A. Semrad, general manager of the Western Light & Power Company, at an electrical luncheon served in the turbine room of the company's Lafayette plant, 12 miles from Boulder. The luncheon was prepared entirely on electric ranges as a practical demonstration of their commercial application.

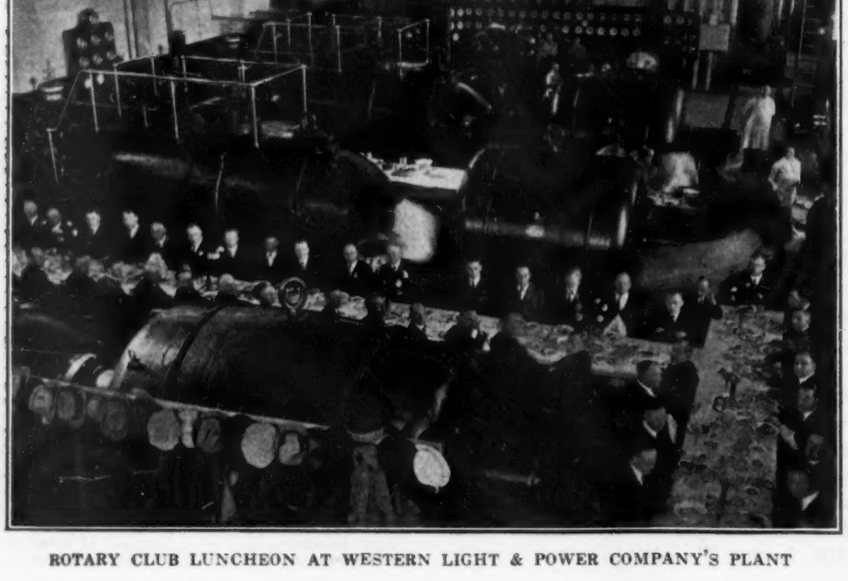
Three electric ranges were installed at the plant especially for the occasion by E. B. Ball, commercial manager, and M. E. Lanning, of the Westinghouse company in Denver. The latter did the cooking, starting the night before in order that oven space might be available immediately prior to serving the meal. The seventy-five Rotarians pronounced the luncheon one of the best ever attended by their club.

Mr. Lanning, having thus established his culinary qualifications at Boulder, is preparing to feature a similar demonstration at Pueblo in conjunction with the Southern Colorado Power Company.

Three Arguments for Better Window Lighting

There are three outstanding conditions which are influencing merchants to adopt higher standards and intensities of illumination in their display windows, declared J. R. Colville of the National Lamp Works of the General Electric Company, before a meeting of the Philadelphia Section of the Illuminating Engineering Society recently. First, the high investment cost of window space, the high pay of window trimmers and the increase in the habit of "window shopping" by passers-by have caused storekeepers to do everything possible to attract attention to their displays. Second, the increase in intensity of street illumination has forced merchants to raise that of window lighting. Third, the drawing power of window lighting in the daytime is becoming better appreciated and the use of artificial illumination in daylight hours is growing.

Another development in the store-window lighting, Mr. Colville pointed out, is the elimination of street reflections by the use of very high intensity illumination. Typical instances have been the use of flood and spot lights where the value of the light on the floor or object displayed is between 3,000 and 4,000 foot-candles.



ROTARY CLUB LUNCHEON AT WESTERN LIGHT & POWER COMPANY'S PLANT

What Other Companies Are Doing

Pueblo, Col.—Although of short duration, the display of a model electrical home here attracted 6,000 visitors. It was open from March 14 to 18, and on the last day of the exhibition nearly 2,000 people were turned away. Because of its success plans are now being made to feature another electrical home during the summer months, with the aid of the Electrical Co-operative League in Denver.

California.—Members of the Edison Road Show Company, a good-will producing unit of the Southern California Edison Company, recently entertained the residents of Redlands with the show, which deals with the development of hydro-electric power in California. Experiments with high-voltage current were also performed for the guests of the company.

Springfield, Ill. — Merchandise sales of the Central Illinois Public Service Company for the third week in March totaled $15,048, which is next to the largest weekly sales the company has made, the high record this year being in January. The January sales exceeded those for the same period in 1922 by 31.4 per cent. The February sales over the same period were greater by 128.1 per cent. The combined sales for the first two months of this year were 73 per cent greater than for the same period in 1922.

Roswell, N. M. — An electrical apartment will shortly be exhibited to the residents of this city as the result of an arrangement between the Roswell Public Service Company and the electrical contactor-dealers. The apartment to be used is that of Carl M. Einhart, general manager of the central-station company. Although no electrical homes have been shown thus far in New Mexico, the movement is under way and other displays will be made in the late spring following the Roswell exhibition.

Hartford, Conn.—To meet the convenience of three thousand local customers, the Hartford Electric Light Company will shortly establish its first branch office in East Hartford, under the resident managership of John Garrett. All business formerly handled at the main office in Hartford can be covered at the new location.

Digest of Electrical Literature

Including Brief Abstracts of and References to
Important Articles Appearing in the Scientific and Engineering Press
from All Parts of the World

Hydro-Electric Development and Steam Equipment

Power Direct from Sunlight.—TITO ROMAGNOLI.—The theories of all present-day projects for getting power direct from sunlight are treated and illustrated in this article.—*Elettrotecnica*, Jan. 5, 1923.

Loss of Head in Valves and Pipes.—C. I. CORP and R. O. RUBLE.—The results of 2,200 tests on forty-eight different gate and globe valves are presented in this bulletin. Results of 425 tests to determine pipe friction are also included. The loss of head due to gate valves ½ in. to 12 in. in diameter was measured for various openings, namely, one-eighth, one-quarter, three-eighths, one-half, three-fourths and fully open. The loss of head due to globe valves ½ in. to 2 in. in diameter was determined under fully open conditions. As a part of the valve experiments the loss of head in pipes of ½-in. to 12-in. diameter was determined, and these results are included in this bulletin. The article is 143 pages long and includes a description of all of the tests, apparatus, methods of experimentation, results and numerous tables of data. There are twenty-two tables giving the loss of head in pipes, gate valves and globe valves.—*Bulletin of the University of Wisconsin, Engineering Series*, 9-1.

Generation, Control, Switching and Protection

Experiences with Lightning Arresters in South Africa.—H. BOHLE.—Very little protection against lightning disturbances was obtained on overhead lines with but one grounding cable above the wires. Three of such cables fastened to a top cross-arm gave fair protection to a three-phase double line, but only in the case of high-frequency discharges. Grounding of the neutral Y-point over large water resistances (water boxes) was effective only if the three phases carried a balanced load. An unbalanced load of as much as 5,000 kva. was found occasionally. In this case the grounding of the Y-point may be a voltage grounding, but not a current neutral grounding, and it is therefore useless. Arcing horns proved to be of no value in South Africa on account of their time lag, during which transformer puncture occurred. The resistance in series with such horns limits the ground current usually to about 15 amp., but as high as 1,000 amp. induction currents will occur frequently. It was observed that buses with well-rounded corners flashed over, while nearby horn gaps set much closer did not function. The sphere gap of the General Electric Company showed in actual service a much smaller time lag and gave results superior to the horn gap. Aluminum arresters give a better performance than other arresters, but necessitate daily charging and have, together with lead-peroxide arresters, the common disadvantage of all spark gaps. Neither of these arresters represents, therefore, a definitive method of protection from lightning.—*Zeitschrift des Vereines Deutscher Ingenieure*, March 3, 1923.

Studying the Motion of Relays.—H. E. IVES and T. L. DOWEY.—In the study of the electrical phenomena accompanying the making and breaking of contacts for relays it is of considerable importance to know definitely how the contact points move relatively to each other. Apparatus is described for photographing the motion of relay points, the shadowgrams of which give information on the performance of the relays, while accurate measurement of the films opens the way for quantitative analysis of the motion.—*Bulletin B-10-1 of the Western Electric Company.*

Transmission, Substations and Distribution

Problems of Parallel Operation of Transformers.—E. WIRZ.—In the theoretical part of this article the author proves that for a perfect parallel operation of transformers not only the same reactance of the two machines is required, but that they also should have the same no-load characteristics. In the second part, which deals with test results to verify the theoretical conclusions, it is shown that transformers with disk coils lend themselves better to a perfect parallel operation than those with barrel or cylindrical windings, and that in the case of operating two transformers in parallel, where the one is built with disk coils and the other with barrel coils, the disk-coil machine should have a smaller reactance. Vectorial analysis is used throughout the theoretical part of the paper. The tests were made on 150-kva., three-phase transformers.—*Bulletin Association Suisse des Electriciens*, January, 1923.

Lightning Disturbances on Distribution Circuits.—M. MACLAREN.—A general survey is presented of the nature and distribution of failures and interruptions due to lightning upon the circuits of the Philadelphia Electric Company. Recommendations are given for improving conditions without specifying any particular make of arresters, in recognition of the fact that a considerable number of different types are proving adequate to meet the conditions imposed upon them on the moderate-voltage systems under consideration. The subject is treated under three principal divisions—115-230-volt distribution circuits, 2,300-volt circuits and 13,200-volt circuits. The number and the nature of the failures on each of these three systems are discussed.—*Journal of the A. I. E. E.*, March, 1923.

An Integral Equation for Skin Effect in Parallel Conductors.—CHARLES MANNEBACK.—The author has obtained the general set of integral equations giving the theoretical solution of the current distribution in parallel conductors by the method of successive approximations. This method is particularly advantageous in giving the approximate solution of skin-effect problems at low frequency for parallel conductors of any shape and number. A physical interpretation of the successive approximations is made. The integral equations as developed may also be used as a check on solutions obtained by other processes.—*Publications of the Massachusetts Institute of Technology, Serial No.* 30.

Economy of Cooling Methods for Large Transformers.—H. SCHULZE.—Only two methods of cooling large power transformers are being considered today in Europe. In one of these methods the hot oil from the transformer is pumped through an oil-pipe system, over which a shower of water is directed. Being arranged within a cooling tower, the same water is used over and over again. The method requires one oil pump and one water pump. The second method dispenses with water entirely and directs a powerful blast of air across the oil-pipe system, requiring one oil pump and one air blower. Experiences obtained on the 100,000-volt transmission systems of Germany have shown that the second method, in spite of its higher initial cost, is more economic and reliable in operation, particularly where the water conditions are not fully perfect as when only impure or carbonated water is available. The heated air, after leaving the oil-pipe system, can be and is being used advantageously to heat the operating rooms of the station or substation, whereas with the first-mentioned method a special steam-heating plant has to be provided. The author gives a detailed cost comparison of these two methods for a station with two 7,500-kva. transformers. The installation costs compare in the ratio of 100 to 117 respectively, but the operating expenses are as 100 to 90, resulting in a saving of approximately 10 per cent.—*Elektrische Betrieb*, Feb. 24, 1923.

Units, Measurements and Instruments

A Direct-Reading Thermionic Voltmeter and Its Applications.—E. B. MOULLIN.—The conditions suitable for constructing a sensitive direct-reading voltmeter from a triode rectifier are discussed and two distinct forms of completed thermionic voltmeters are described. The power absorbed by a rectifier is discussed theoretically, and a description is given of the experimental

methods of measuring the effective resistance of a thermionic voltmeter. Possible causes of frequency errors in the calibration of the voltmeter are considered and the results of experiments are quoted, showing that a calibration made at low frequencies is reliable up to at least one million periods per second. Several typical illustrations are given of the uses of a thermionic voltmeter in measurements at both high and low frequencies.—*Journal of the Institution of (British) Electrical Engineers*, February, 1923.

History of Electric Meters.—W. STUMPNER.—The article deals in a general descriptive manner with the development of the direct-current ampere-hour and kilowatt-hour meters, embracing the chemical, electromechanical and motor principles. Except for a description of a few thrust-bearing constructions, only a few technical details are given in the paper, the main interest of which lies in its many illustrations.—*Siemens Zeitschrift*, February, 1923.

Maintaining Small Objects at a Constant Temperature.—P. P. CIOFFI and L. S. TAYLOR.—An apparatus for maintaining small objects at any temperature between —180 deg. C. and +20 deg. C. is described. The method consists in surrounding the object to be cooled by a stream of cold, dry air, while keeping any surfaces exposed to the free atmosphere above 0 deg. C. The cold, dry air is obtained by evaporating liquid air in a Dewar flash by an electric heater immersed therein.—*Bulletin B*-18-1 *of the Western Electric Company.*

Motors and Control

Electric Drive in Steel Mills.—A. RUSCHOWY.—A general description of a great variety of modern electric installations in steel mills, comprising gas-driven central stations, rolling-mill motors, coal-conveying plants, Ilgner flywheel sets, Leonard motor-generators and a 13-ton induction furnace installation of the Frick type. The paper is well illustrated with machines built by three of the largest European manufacturers.—*Elektrotechnik und Maschinenbau*, Feb. 18, 1923.

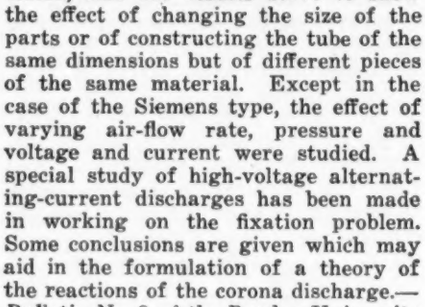
Electric Heating for a "Shrink Fit."—A. GANDENZI.—To fasten securely the shaft of a 4,000-kw. rolling motor into its large rotor casting a "shrink fit" was decided upon. The necessary shrinkage was calculated to from 0.5 mm. to 0.6 mm., requiring the heating of the bulky casting to about 200 deg. C. to 220 deg. C. To accomplish this without undue loss of time and with greatest accuracy, electric heating was resorted to, using alternating current in a few turns of cable around the rotor hub as a short-circuited secondary. A number of calibrated thermocouples, placed at different points on the hub, measured the rising temperature during the process. The job was successfully finished in sixteen hours, consuming 50 kw., of which 3½ kw. were the copper losses in the cable.—*Brown-Boveri Mitteilungen*, March, 1923.

Electrophysics, Electrochemistry and Batteries

Production of Nitric Oxides and Ozone by High-Voltage Electric Discharges.—K. B. MCEACHRON and R. H. GEORGE.—A bulletin of 189 pages presenting the results attained in investigating various types of tubes to which electrical discharges are confined. The material presented is grouped under four general heads, corresponding to the type of tube employed and classified as the Siemens tube, the rod-type tubes, the single dielectric tube and tubes using spark discharges. All these tubes are described in detail in connection with the tests made with them. As a rule several tubes of the same type were tested, and the results serve to show the effect of changing the size of the parts or of constructing the tube of the same dimensions but of different pieces of the same material. Except in the case of the Siemens type, the effect of varying air-flow rate, pressure and voltage and current were studied. A special study of high-voltage alternating-current discharges has been made in working on the fixation problem. Some conclusions are given which may aid in the formulation of a theory of the reactions of the corona discharge.—*Bulletin No. 9 of the Purdue University Engineering Experiment Station.*

Traction

Articulated Connecting Rods for Electrical Locomotives.—G. BIANCHI.—The author describes the new system of transmission of motive power recently



ARTICULATED CONNECTING RODS APPLIED TO HIGH-SPEED ELECTRIC LOCOMOTIVES

applied to a high-speed electric locomotive built for the Italian State railways. This system has the advantages of being much lighter than the old arrangement and of transmitting to the drivers the horizontal components only of the efforts at the cranks of the motors. Points 1 to 8 of the accompanying illustration show where the articulations have been made. The design of the system is briefly treated and general considerations are given.—*Elettrotecnica*, Vol. 9, No. 33.

Development of Mercury-Arc Rectifiers—A. ODERMATT.—The writer compares the rectifier with a stationary commutator around which the arcs circle as brushes, without mechanical inertia or friction and with the speed of the frequency. The originally somewhat wavy character of the resulting direct current can be easily smoothed out with properly dimensioned iron-core choke coils. The latest Brown-Boveri constructions of rectifiers are described in the paper with several photographs of recent installations. A rectifier shows an efficiency of its cylinders of 96 per cent operating on 500 volts, 98 per cent operating on 1,000 volts and 99 per cent operating on 2,000 volts. For a substation of, for example, 200 kw. output with an average load of 80 kw. the following over-all efficiencies may be obtained: Motor generator, 70 per cent; rotary converter, 83 per cent; mercury-arc rectifier, 94 per cent. Good comparisons were obtained from actual meter readings in a substation for an 850-volt direct-current suburban railway, operating once with rotaries and once with rectifiers. At 1,042 kw.-hr. delivered to the road the rectifier consumed 1,110 kw.-hr., while the rotary consumed 1,203 kw.-hr., or a saving of 93 kw.-hr. per day. Assuming a cost of 10 centimes per kilowatt-hour, a yearly saving of 3,390 francs, or 10 per cent of the cost of the rectifier, was realized. A rotating rectifier plant may therefore be replaced by a mercury rectifying plant practically without cost, the latter paying for itself by its much more economic operation.—*Elektrotechnik und Maschinenbau*, March 4, 1923.

Telegraphy, Telephony, Radio and Signals

Acoustic Efficiency of Thermophones of the Heated Foil or Wire Type.—E. C. WENTE.—Theoretical formulas are derived for the maximum value of the alternating pressure produced within the inclosure of any thermophone when a given alternating current, superposed on a direct current, is passed through the central foil or wire. The effect of certain simplifying assumptions which are made is shown to be small in practical cases. As an experimental verification of the formula, an electrostatic transmitter was calibrated for a wide range of frequencies with four thermophones which differed greatly in their physical constants, the formulas being used to compute the pressures produced. The four calibrations thus obtained agree with each other closely and also with an independent calibration made with a pistonphone.—*Bulletin B*-6-1 *of the Western Electric Company.*

Signaling Increases Capacity of Three Tracks.—Automatic signaling and interlocking plants will play an important part in handling the traffic on the 21-mile stretch of third track now nearing completion on the Illinois Central between Monee, Ill., and Kankakee. The outstanding feature of this installation is the fact that the routing of trains on the three tracks is left to the towermen, conflicting moves on the middle track, which is signaled for both directions of traffic, being prevented by electrically interlocked circuits between the towers. The two outside tracks are signaled for the normal direction of traffic, while the middle track is signaled with one-mile blocks for both directions of traffic. The track layouts and crossovers are so arranged that a towerman can divert a train from either outside track to the center track or the reverse.—*Railway Age*, March 3, 1923.

New Books

Reviews of the Latest Contributions to
Technical, Industrial and Commercial Literature of Particular Interest
to Members of the Electrical Industry

The Induction Voltage Regulator

By E. F. Gehrkens. Schenectady, N. Y.: General Electric Company. 516 pages, illustrated.

The induction regulator is a valuable and essential device on large systems, and the author has presented the theoretical and practical aspects of regulator design and application in a splendid manner. The general operating and design principles are discussed, and yet the major portion of the book treats of the applications of the various types of regulators. The auxiliary equipment used is also discussed and explained. This volume should prove very helpful to operators who use the regulator, to students and to those who desire to study the device in all of its detail.

Electricity and Its Application to Automotive Vehicles

By P. M. Stone. New York: D. Van Nostrand Company. 844 pages, illustrated.

The electrical features of the automobile have become necessary and valuable adjuncts to the mechanical equipment. But the confined space in which the electrical apparatus is contained, its own character and the rapid developments in the art usually make it difficult for the owner or mechanic to master the workings of the equipment. In this book a teacher in an automobile school has written down in text form the fundamental principles of electricity and then applied them to the operation and installation of automotive electrical equipment. A judicious exercise of theory and practice has resulted in a valuable book for car owner, mechanic or student. Among its commendable features are the chapters devoted to "Trouble Shooting," "Testing" and "Splicing and Soldering."

The book is well illustrated and contains drawings and descriptions of representative installations. It is an excellent addition to the automotive text series.

Relativity and Space

By C. P. Steinmetz. New York: McGraw-Hill Book Company, Inc. 126 pages, illustrated.

The versatility and deep knowledge of Dr. Steinmetz are well proved by the four lectures contained in this volume. He has made a very successful explanation of the meaning of relativity for the lay mind by using analogies and the synthetic method of attack. Even though the relativity theory cannot be grasped completely without the use of mathematics of higher degree, Dr. Steinmetz has brought out the philosophy, the science and a great deal of the physical meaning of the theory. The book contains some mathematics of a simple type to illustrate more accurately certain of the conceptions involved in relativity. The last lecture is devoted to the conception of mathematical space and exemplifies the power of thought, the lucid expression and the logical analysis for which Dr. Steinmetz is noted. This is a worthwhile book for all engineers interested in a fascinating subject.

Ultra-Violet Radiation

By M. Luckiesh. New York: D. Van Nostrand Company. 258 pages, 12 plates.

It is a remarkable fact that, despite the great amount of research which has been spent on ultra-violet radiation and its importance both theoretically and practically, no book dealing with the subject has appeared since the little volume of Prof. S. P. Thompson a good many years ago, when knowledge of the subject was scarce. Mr. Luckiesh has done a real favor to the engineer and the investigator by gathering together with no little patience and much discriminating judgment many data on the ultra-violet and its properties. He first acquaints the reader with the nature and history of the subject and then takes up in turn solar radiation, the transparency of gases, liquids, solids and glasses, the reflection of the ultra-violet by various substances, its occurrence in common illuminants, the experimental sources for such radiation, its detection and measurement, and its physiological and photo-chemical effects. The treatise thus forms an extremely useful summary of the present state of knowledge of fundamental facts regarding short-wave radiation, the more valuable in that it is provided with very full bibliographical notes. Mr. Luckiesh makes no attempt to deal *ex-cathedra* with moot problems, but sets out in his usual effective and interesting way the things which are known, leaving disputed questions to be dealt with by reference to the original papers.

The data on transmission and reflection of the ultra-violet, which are given somewhat fully, will be found most convenient for the investigator, who will discover assembled here data which would take him long to dig out of the somewhat scattered literature of the subject. One may, in fact, say without exaggeration that here is a book that should be at the elbow of any one who is working or expecting to work on the ultra-violet region of the spectrum. Science certainly owes Mr. Luckiesh a debt of gratitude for having gone to the pains to put so effectively a great mass of facts ready to its hand.

LOUIS BELL.

Schaltungen von Gleich und Wechselstrom Anlagan

By E. Kosack. Berlin: Julius Springer. 155 pages, 226 illustrations.

Books of this character are usually a collection of more or less monotonous wiring diagrams with the necessary text, all reference to auxiliary apparatus being omitted. The author has carefully avoided this fault by using as examples the diagrams of plants in actual operation and omitting calculations wherever possible in order to reduce the mass of material to the dimensions of a much condensed volume. Very plain diagrams, conforming to the latest rules of the Vereines Deutscher Ingenieure, are used throughout the book. Its ten main sections are devoted to connections for switches and protective apparatus, lamp wiring, measuring instruments, direct-current plants, direct-current motors, alternating-current plants, transformer stations, alternating-current motors, connections of substations with rotating apparatus like motor-generators, rotaries, cascade groups, etc., and, finally, starting and regulating devices. The progress made in late years in Europe through the mercury-arc rectifiers, which have become in many instances serious competitors of rotaries or motor-generators, is not made manifest in the scant two-page treatment of their connections.

A. PALME.

Books Received

Electric Toy Making. By T. O'Conor Sloane. New York: The Norman W. Henley Publishing Company. 254 pages, illustrated.

Jahrbuch der Elektrotechnik. 1920. By Dr. Karl Strecker. Munich and Berlin: R. Oldenbourg. 232 pages.

Tait's Electrical Directory of Australia and New Zealand. Sydney: Tait's Publishing Company. 224 pages.

Electrical Engineering Laboratory Experiments. By C. W. Ricker and Carlton E. Tucker. New York: McGraw-Hill Book Company. 310 pages, illustrated.

Interior Wiring and Systems for Electric Light and Power Service. By Arthur L. Cook. New York: John Wiley & Sons, Inc. 458 pages, illustrated.

Metals and Their Alloys. By Charles Vickers. New York: Henry Carey Baird & Company, Inc. 767 pages, illustrated.

American Society for Testing Materials—Index to Proceedings. Volumes XIII-XX (1913-1920). Philadelphia: American Society for Testing Materials.

Printing Telegraph Systems and Mechanisms. By H. H. Harrison. London: Longmans, Green & Company. 435 pages, illustrated.

Elektrotechnische Messinstrumente. By Konrad Gruhn. Berlin: Julius Springer. 223 pages, illustrated.

English and Engineering. Second Edition. By Frank Aydelotte. New York: McGraw-Hill Book Company, Inc. 415 pages.

News of the Industry

Chronicle of Important Events and General Activities, Announcements and Reports of Association Meetings, Court Decisions and Commission Rulings and News of Electrical Men

Promote Superpower Plan

Superpower Advisory Board and the F. A. E. S. to Act in Concert on Atlantic Coast Project

A LEGAL committee headed by Edward G. Buckland, general counsel of the New York, New Haven & Hartford Railroad and a member of the Superpower Advisory Board, will ascertain in the near future what state laws interfere with the building up of a superpower system on the North Atlantic Coast and what legislation is necessary to bridge over these laws. The Federated American Engineering Societies will co-operate with the Superpower Advisory Board in an effort to revive activity looking to the practical application of the plan. It is believed that the time is particularly opportune since the earnings of railroads and utilities now are such as to justify improvements of an electrical character which, because of reduced earning power, could not have been undertaken at the time the superpower report was made. It is believed that earnings during this peak of business activity had better go into improvements requiring large capital but making for ultimate economies rather than allow rate reductions to be made on the basis of present earnings.

Letter to Governor Smith

As one of the uncertainties in the superpower situation at this time is the attitude of the Governor of New York toward the plan, L. W. Wallace, the executive secretary of the Federated American Engineering Societies, has addressed the following letter to Governor Smith:

"The engineering profession is very much interested in seeing secured for the public the economies and benefits which would follow the building up of a superpower system in the Boston-Washington area. I am wondering if the superpower plan proposed for this area would conflict with your policy. The advantages to New York, I believe, would be many were resort had to greater interconnection. So far as New York is concerned, it probably would be largely a matter of importing power. Exports of energy would be confined largely to offpeak loads, which would make possible uniform operation of plants in New York.

"I am not attempting to present the advantages and disadvantages of the superpower system. I am not willing to conclude before learning your opinion that you would oppose such a system or would object to New York's consideration of a compact between the states concerned which would make uniform the regulation of such a utility. I shall be grateful to you indeed if I may have your thought on the foregoing points."

For Adams-Albany Line

Harriman Outlines Value of This Interstate Tie—Pittsfield Company Withdraws Opposition

MARKED benefits in the utilization of streams with diverse flowage characteristics, coupled with more effective operation of steam plants, will result from the interconnection of the New England Power Company's system with that of the Adirondack Power & Light Company, declared H. I. Harriman, president of the former company, at a recent hearing before the Massachusetts Department of Public Utilities upon a petition for authority to issue securities to finance this and other improvements. It is proposed to build a transmission line across western Massachusetts from Adams to Albany, N. Y., permitting flexible operation of the hydro-electric and steam stations on each system. Mr. Harriman pointed out that while the great seasonal variations in flow are synchronous on the watersheds of the two systems, the intermediate variations are asynchronous and susceptible to more efficient utilization through tie-line operation. Coal costs from $1.50 to $2 per ton less at the Amsterdam (N. Y.) steam plant of the Adirondack company than on the New England system, and the former has recently contracted with the International Paper Company for 40,000 kw. more water power. Completion of this interconnection will effect electrical solidarity from Boston to Utica.

Pittsfield Company Withdraws Opposition

During the hearing the Pittsfield (Mass.) Electric Company withdrew opposition that it had exerted against the New England company's petition in view of the latter's withdrawal of its projected Lanesboro substation in the Pittsfield district, and upon the understanding that the construction of the Adams-Albany tie line would be for trunk-line interconnection purposes and not for the supply of local loads within the Pittsfield company's area of service. The early interconnection of the latter with the Turners Falls Power & Electric Company's system, it was set forth, will insure ample power supply to the Pittsfield district as future business develops.

Superpower in Northwest

Survey Committee for Upper Pacific Coast Finds No Present Need for Ambitious Plan

A CAREFUL study of power conditions in the Pacific Northwest has just been completed by the Superpower Survey Committee organized two years ago, as reported in the ELECTRICAL WORLD for April 30, 1921, page 1008. D. C. Henny of Portland, Ore., was the chairman of this committee, and it included representatives of electric light and power, railroad and commercial companies in Oregon, Washington and Idaho. The committee reports that the situation in regard to developed water power as well as feasible undeveloped sites is so favorable throughout the Northwest that there is no need at present of a superpower line. Present inter-tie lines of medium capacity, it holds, make ample provision for the comparatively small interchange of power necessary from one district to another and for reasonable insurance against service interruption.

Final Plans for Pittsburgh Meeting of A. I. E. E.

An important group of papers covering the vital phases of the grounding of transmission systems will, as already announced in the ELECTRICAL WORLD (March 31, page 767), be presented and discussed at the spring convention of the American Institute of Electrical Engineers, which will be held in the William Penn Hotel, Pittsburgh, on April 24 to 26 inclusive. The report of the sub-committee on grounding of systems will analyze the practices used for transmission of more than 6,000,000 kva. of energy over 30,000 miles of transmission lines at voltages up to 150,000. This report will show very wide divergence in practice, for, while grounding the neutral prevails, a number of important systems are still operating ungrounded. Although the use of resistance in the grounding circuit is becoming increasingly common, the value of such resistance shows no uniformity, according to the report, which will also show that the Peterson coil used on one system has a very creditable record. A deviation has been made from the program as printed on March 31 in that W. W. Woodruff, Philadelphia Electric Company, will handle the report on "Systems Transmitting at Generated Voltage" and E. C. Stone, Duquesne Light Company, the report on "Systems Transmitting at Higher than Generated Voltage."

The banquet to be held on Wednesday evening will be of unusual importance as a meeting. President Jewett will preside, and the speakers will be Philip P. Wells, who will represent Governor Pinchot of Pennsylvania, and Paul T. Brady of the Westinghouse Electric & Manufacturing Company. They will discuss "Superpower—a National Resource."

E. C. Stone, Duquesne Light Company, chairman of the Pittsburgh Section, American Institute of Electrical Engineers, is chairman of the general committee in charge of arrangements for the convention. Engineers expecting to attend the convention are requested to communicate with W. C Goodwin, chairman committee on regis tration, in care of the control engineering department, Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pa., at the earliest possible moment in order that convenient hotel accommodations may be secured.

Ten-Million-Dollar Plant for Houston

It is announced by Edwin B. Parker of Houston, Tex., president of the Houston Lighting & Power Company, that that company will immediately construct the first unit of an electrical generating plant. This unit will cost $4,000,000. The plant will ultimately be the largest in Texas and will entail an expenditure of $10,000,000. Excavation for the building has already been started. It will be built on a 98-acre tract of land, fronting 1,200 ft. on the Ship Channel, owned by the company. The equipment of the first unit will be two turbo-generators, each of 20,000 kw. rating. The construction of three additional units of 40,000 kw. rating each is planned, bringing the total ultimate production of the new plant to 160,000 kw.

"The idea in the minds of the executives of the Houston Light & Power Company," said Mr. Parker, "is to build ahead of the probable needs of the city. Then, as the needs increase, the facilities of the Ship Channel plant will be added to from time to time until the four units are completed. The new plant will be maintained independently of the present plant, which will be used as an emergency plant. At present there is a demand for 5,000 kw. in the immediate vicinity of the proposed plant on the Ship Channel. The remainder of the energy will be transmitted to the present plant over two cables, one on the north and one on the south side of the channel. Each transmission line will be capable of carrying the entire load.

"The present capacity of the company's plant is 32,500 kw. This will be increased by the power from the channel plant by 35,000 kw. upon the completion of the first unit. The turbines are being built by the General Electric Company and will be ready for installation as soon as the building is completed, which will be in about twelve months."

Explosion in Indianapolis

Turbo-Generator in Mill Street Power House Is Blown to Pieces and Building Damaged

A LOSS estimated at $1,000,000 in damage to machinery and interruption of service was caused, two men were hurt and light and power service over most of the city was paralyzed about 5 a. m., Monday, April 2, when a 12,500-kw. steam-electric turbine in the Mill Street plant of the Indianapolis Light & Heat Company exploded. Pieces of the giant turbine were thrown in all directions, and the interior of the engine room at the plant was wrecked. Two other turbines were temporarily put out of commission. Fire started and an alarm was sent in, but at no time did it assume serious proportions.

The turbine was on a slightly raised platform in the north end of the engine room at the plant, which is a three-story brick structure. One piece of the unit wrecked traveled the length of the plant and crashed through a window at the south end, a few feet beneath the eaved roof. Other pieces crashed through windows nearer the wrecked turbine. Holes were torn in the roof.

PROMPT RESTORATION OF SERVICE

Officials expect soon to have a 19,000-kw. steam turbine in service at the plant to supplement the 5,000-kw. and 19,000-kw. turbines which have been restored to service and now bear the load there. While all demands on the plant are being supplied, the explosion created a situation in which it has had to operate the two turbines now in use beyond their rating. Addition of the extra turbine will relieve the strain. Experts say repair of the turbine that exploded is virtually impossible.

Despite the extensive damage done by the explosion, officials of the Indianapolis Light & Heat Company, are going ahead with plans for the year's development work, according to a statement made by President C. C. Perry. The only change in the program, Mr. Perry said, was to include greater generating equipment for the two large central power stations owned by the company, so that in event of another accident the ordinary light and power load can be taken up and served by the remaining station. This change in development plans calls not only for the installation at the Mill Street plant of the 19,000-kw. turbine just mentioned to take the place of the generator destroyed, but also of another turbine of the same capacity for the Kentucky Avenue plant. When all the equipment ordered has been installed the company will gain an increase in generating capacity of about 35 per cent.

Public Service Electric to Build Superplant

Plans have been completed by the Public Service Corporation of New Jersey for the erection near Newark of a superpower steam-electric generating station with an initial installed capacity of 200,000 hp. and an ultimate capacity of 400,000 hp. Construction will begin soon. The new station will be interconnected with the Public Service Electric Company's system, and power will be distributed through the densely populated industrial sections of New Jersey, where the demand for energy exceeds the supply. Electricity is now supplied to 337,500 customers in 202 communities. The new installation when completed will bring the Public Service Electric Company's total generating capacity up to 720,000 hp.

HAVOC WROUGHT THROUGH BURSTING OF TURBO-GENERATOR IN INDIANAPOLIS POWER HOUSE

Rural-Service Charges

Discussion Before Indiana Commission on Rate Including Percentage of Equipment Cost

AT A RECENT hearing by the Public Service Commission of Indiana on proposed rules for the extension of electric utility service into rural territory, much attention was given to a proposed additional rate to be paid for energy for rural service as compared with the rate in the city from which extensions are made, this additional charge to equal 10 per cent of the total cost of the general and local equipment included in each separate extension. E. J. Condon of Angola said that in view of the fact that the farmers are to pay for the cost of the extension, including general and local equipment, it would be difficult to explain to them why an additional rate of 10 per cent of the cost of such equipment should be added to their bills every year. Roy Thurman of the Indiana General Service Company, which had submitted the proposed rules, answered that the 10 per cent was to take care of depreciation, taxes and excess maintenance cost of rural over city lines.

H. A. Nichols of the Union Traction Company submitted that the 10 per cent addition to the rate, on the basis proposed, would make complicated bookkeeping. He thought it would be better to establish a minimum monthly charge of about $2.50 a month and add about 25 per cent to the bill to cover the extra costs of rural service. A farmer or a group of farmers would pay for the general and local equipment, and title would rest in the utility company.

The utility men present took the position that it would be of no advantage to them to have title to property that had been paid for by the farmers, and that such title would be a liability rather than an asset, because the utilities would have to pay taxes and maintain the property. Commissioner Ratts, who presided, said that placing title in the utilities would result in better maintenance.

In the rules as first proposed for adoption 10 per cent to cover contingent expenses, cost of accounting and other items and 10 per cent to cover engineering supervision and the use of tools were added to the actual cost of equipment for an extension. It was said by some of those present that farmers would object to these charges, and Earl Carter, chief engineer of the commission, suggested that the actual engineering and supervision costs in dollars be included in the cost of equipment and only one 10 per cent be added, this to cover contingent expenses and cost of accounting.

Civil Engineers Vote Not to Join F. A. E. S.

By a vote of approximately 3,600 to 2,100, the American Society of Civil Engineers has again decided not to join the Federated American Engineering Societies. This vote proceeded during the month of March, closing on April 1, and was canvassed April 6. This question has been a very live one with the civil engineers and briefs pro and con have been widely circulated. The feeling among other engineers is one of regret, with the belief that the civil engineers have not fully comprehended the opportunity for service by means of the F. A. E. S. organization.

Italy Turns Back Telephones to Private Hands

A decree whereby the telephone systems of Italy, heretofore a government monopoly, are to be turned over to private industry and completely reorganized has been issued, in accordance with previous announcement, by the Italian government. Under this decree, the government, by virtue of its grant of full powers in administrative matters from Parliament, may grant to public or private companies or individuals right to operate the state telephone systems, with eventual ownership. It will oblige the concessionnaires to improve the systems according to a program established by the state administration, giving preference in the purchase of materials to the national industries.

The duration of these concessions is unlimited, with a minimum in each case of twenty-five years. Right of repurchase by the state is reserved. The cession of the systems may be either by payment of value or by the admission of the state as a stockholder in the company. The concessionnaires will pay to the state an annual amount not less than 5 per cent of the gross receipts of their respective companies, as shown in the annual budget, and a share in progressive degree of the net returns on capital when these exceed 7 per cent.

First Convention of Middle West Division

Commercial Section Discusses Increase of Residential Business and Importance of Sales Department—Social Aspects of Electric Service—Selling Bonds to Customers

THAT residence customers can be educated to the use of from forty to fifty kilowatt-hours as an average monthly consumption was asserted by N. T. Wilcox in presenting his report as the chairman of the Commercial Section of the Middle West Geographic Division of the National Electric Light Association at the first annual convention of the division, which began on Wednesday, April 11, at St. Louis. Mr. Wilcox said that the average monthly residential consumption in most sections of the country now is under 20 kw.-hr., a figure at which the expense of establishing and maintaining the service is not returned to the utilities. The larger figure that ought to be reached, he said, is exclusive of the use of ranges, refrigerators or like household equipment. Mr. Wilcox characterized residential business as one of the most important fields for the development of energy sales.

Importance of Commercial Men

E. W. Lloyd of the Commonwealth Edison Company, Chicago, thought that the central-station commercial man in many organizations does not occupy the position to which the importance of his work entitles him because central-station executives often do not themselves appreciate that his position ranks with the most important in the organization. Executives must realize that the commercial department is in the same position in the central station as in any other business which must depend on the ability of its sales forces to market its products. He criticised the attitude of the commercial man who looks on his position merely as a stepping stone to something else, thus defeating the very objects for which he should be working.

R. F. Schuchardt, Commonwealth Edison Company, asserted that the time has gone by when central-station men can ignore the National Electric Light Association and the opportunities it gives for development of men and methods through the broad contacts it affords. He said that executives who refuse to allow their men to participate are sinners against their stockholders by depriving them of potential increased returns as well as against their employees.

Social Aspects of Electric Service

The social aspects of the distribution of electricity were presented by Paul Winthrop Brown, who said that electricity has so multiplied the power of men to accomplish tasks that, in spite of the increase of wealth and population in the United States, the servant classes have decreased, although in the past history of the world an increase in wealth has always brought an increase in their number.

Louis H. Egan, president Union Electric Light & Power Company, St. Louis, discussing customer ownership, called attention to the fact that the supply of preferred stock will not permit an indefinite continuance of the present methods of selling securities to customers and predicted that in time bonds and other securities would be sold in the same way.

The annual banquet was held Wednesday evening. President Smith, Vice-president Davidson and Executive Manager Aylesworth of the N. E. L. A. were the speakers.

Better business development, public relations and rural lines were discussed at the Thursday sessions.

Pennsylvania Men Confer

Relays and Automatic Stations Are Discussed at N. E. L. A. Meeting at Wilkes-Barre

A MEETING of the Pennsylvania Electric Association, which forms part of the Eastern Geographic Division of the National Electric Light Association, was held in Wilkes-Barre, Pa., on April 6 at which several good papers were presented and discussed by the members. The meeting was preceded by a luncheon, A. J. Llewellyn, general manager of the Luzerne County Gas & Electric Company, acting as toastmaster. The eighty visiting members were addressed by R. R. Van Horn and Mayor Daniel L. Hart of Wilkes-Barre. Following the luncheon E. A. Lewis and Paul Sporn discussed relay protection on interconnected systems. Mr. Sporn pointed out that relays should be installed to satisfy any operating condition and should clear trouble and also maintain service. He said that differential protection had worked out satisfactorially in safeguarding equipment and that the use of overload and directional relays had become standardized on ring systems. On outgoing parallel transmission lines he recommended the mechanically balanced relay and for the incoming ends of such lines the electrically balanced relay.

Standardization of wood-pole line construction was taken up by R. R. Curtis, who said that the practices of the Luzerne County Gas & Electric Company were largely based on the National Safety Code. A standardized construction code book has been developed which works very well on the system, and standardization is gradually being obtained that will permit any service man or lineman to work intelligently on any part of the system. Fir cross-arms with six pins have been adopted, as have standard conductor sizes. No. 0 hard-drawn copper is used on all transmission lines, No. 0 insulated wire on primary mains and No. 4 on branches. In three-wire service the neutral is made one-third the size of the outer wires. Standardized makes and sizes of insulators are used on the different circuits in the system. In discussing the paper the opinion was expressed that great improvement had been made in the quality of insulators and construction materials, but in many cases difficulty had been found in obtaining insulators for guy wires on crossings with factors of safety equal to the specification set by the Public Service Commission. Further discussion brought out the fact that three-wire service had been used to good advantage on 2,300, 4,000, 6,600 and 11,000-volt circuits.

AUTOMATIC SUBSTATIONS

An illustrated lecture on automatic substations was given by Chester Lichtenburg in which the author indicated the rapid strides made in the art as applied to motor-generator, rotary converter and transformer substations. The wide adoption of the reclosing circuit breaker for substation use was advocated and numerous slides were shown of actual automatic installations. A lively pro and con discussion of the paper was followed by a short talk on education by J. G. Osterhaut and a talk on accident prevention by Paul Kuhn.

Delegations were present from points as widely separated as Baltimore and Pittsburgh and widespread interest was shown in plans for future section activities. The next meeting of the association will be in Johnstown on May 8.

Millikan on the Big and Little in the Universe

Gulliver in his travels never saw wonders to compare with those now known to exist in the universe. So declared Dr. R. A. Millikan, director of the Norman Brooks Laboratory of the California Institute of Technology, Pasadena, in an address made on Wednesday evening, April 11, to the New York Section of the A. I. E. E. He first discussed the big things of creation, dwelling on the indications from late researches that the universe has finite dimensions and picturing it to the audience by visualizing distances in terms of pin points, oranges and miles. The past decade, in the opinion of Dr. Millikan, has witnessed more progress in scientific knowledge and accomplishments than any other period of history and has made possible a comparatively exact knowledge of matter, energy and space.

Turning from the big things to the small things of creation, Dr. Millikan then discussed atomic structure and electrons. Radio activity, he said, is now considered a general property of matter and all matter is apparently made up of atoms containing a nucleus of positive and negative electrons which restrain other electrons having orbital movements about the nucleus. The quantum idea of sudden changes in energy, matter and space conditions has been pretty well established by late experiments, the lecturer thought, and in the consideration of how energy from the ether is obtained by the electrons the hypothesis that the quantum is part of the electron, and not the corpuscular hypothesis, is, he held, the correct one.

Dr. Millikan discussed recent experiments at high altitudes which gave indications that hard ray emanations exist in space and furnish the energy required to expel electrons, both positive and negative, from the atom. He also said that, although present experiments permitted only a breaking down of atoms with resulting changes in matter, no reason existed to doubt that atoms could be built up to produce equally startling changes in matter.

At the business meeting of the section Calvert Townley, the retiring chairman, announced the election of these officers for the ensuing year: Chairman, L. F. Morehouse; secretary, E. B. Meyer. F. M. Feiker and Prof. J. H. Morecroft were made members of the executive committee.

Remands Potomac Case

United States Supreme Court Disclaims Jurisdiction at This Stage of Proceedings

THE dismissal by the United States Supreme Court of the appeal of the Public Utilities Commission of the District of Columbia from a decision of the District Court of Appeals which had directed the District Supreme Court to proceed further in the injunction proceedings instituted by the Potomac Electric Power Company in resisting a rate reduction means virtually that there must be a revaluation of the company's properties for the purposes of rate making by the District Supreme Court or, under its order, by the Public Utilities Commission.

Chief Justice Taft, speaking for the unanimous court, declared invalid that section of the act creating the District of Columbia Public Utilities Commission which sought to convey the right of appeal to the United States Supreme Court in cases in the condition of that at issue. The Chief Justice held that this section attempted to confer legislative authority upon the court. The unconstitutionality of the section did not, however, affect the validity of the remaining sections of the act. Appeal will be permissible in cases which have been completed in the lower courts.

HISTORY OF THE CASE

The original lawsuit, now referred to the lower courts, involves a question of principle in fixing the valuation of public utilities for rate-making purposes. When the commission began valuation of the properties of the Potomac company in 1915 it took reproduction values as of July 1, 1914. In deciding the case in 1917, the commission added the actual cost of replacements between July 1, 1914, and July 1, 1916. The commission fixed the value as $11,231,000 and ordered a reduction in rates of 20 per cent. The company asserted that reproduction values should have been as of Dec. 31, 1916, and sought an injunction declaring the new rates unlawful, unreasonable and inadequate. The company alleged a fair value of the property to be $15,642,000 and that other property worth $5,000,000 had been illegally excluded from the valuation by the commission. The District Supreme Court dismissed the bill, but the District Court of Appeals reversed this decision. The commission appealed to the United States Supreme Court.

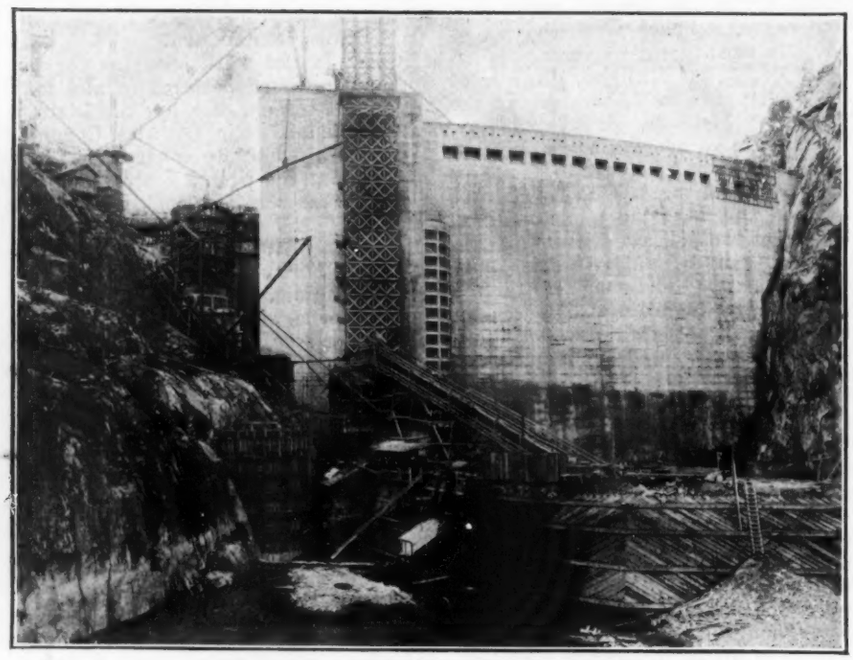
While the litigation has been pending the old rates—which were 10 cents per kilowatt-hour for domestic consumers—have been in operation in the District of Columbia, the difference between these rates and those ordered by the commission being impounded until final disposition of the case. This impounded fund is now nearly $4,000,000 and is increasing by $100,000 a month.

Pronouncements of the Public Utilities Commission of the District made since the case went to the United States Supreme Court will be found under this week's "Commission Rulings."

Hetch Hetchy Nearly Ready

San Francisco's Big Water and Power Plant Will Have an Initial Rating of 80,000 Kva.

CONSTRUCTION work on the Hetch Hetchy domestic water supply and power project of the city of San Francisco is progressing rapidly, and city officials estimate that the Moccasin Creek power plant will be ready for operation before the middle of 1924. An 18-mile tunnel will convey the water for domestic supply and power from a diversion dam several miles below the main Hetch Hetchy dam to the forebay near the Moccasin Creek power house. Sixteen miles of this tunnel has been bored, and the work will be completed within four months. One-third of the 5,000-ft tunnel from the forebay to the penstocks has been driven; excavation for the four penstocks has been completed; excavation for the power house is under way; contract has been awarded for the structural-steel frame of the power house, and both electrical and hydraulic equipment has been under contract for some time. Delivery is to be made on all power-house equipment before Aug. 31 of this year, and the plant is expected to be in operation within eighteen months.



UPSTREAM VIEW OF HETCH HETCHY DAM

This dam, which will store San Francisco's domestic water supply and develop 60,000 hp., is 226 ft. above the former stream bed and is now almost completed.

Four 20,000-kva., 257-r.p.m., three-phase, 11,000-volt generators will be installed under the present contract. These will be driven by 25,000-hp. double overhung impulse waterwheels operating under an effective head of 1,250 ft. Eight 36-in. hydraulically operated gate valves will control the flow of water at the point where the penstocks enter the power house. An overhead crane with a span of 50 ft. and a capacity of 135 tons will be included in the power-house equipment.

Surveying crews are now in the field locating the 135-mile double-circuit steel-tower transmission line from the Moccasin Creek power house to San Francisco. This line will be completed and ready for service before the power plant is finished. For the mountain and valley section of the transmission line a total of 525 miles of steel-core aluminum cable has been ordered. This will be 250,000-circ.mil copper equivalent, having a cross-sectional area of 389,000 circ.mil. Order has been placed for 177 miles of hemp-core copper wire with an area of 345,000 circ. mil for the San Francisco Bay division of the transmission line. Outdoor transformers and switching equipment will be used at the power house. The generator voltage of 11,000 will be stepped up by thirteen 6,667-kw. single-phase transformers to 115,000 volts delta or 154,000 volts star. Both oil and air-break switches will be used and all transmission and other equipment will be insulated for 154,000-volt operation.

Report of Engineers' Committee on High Dam

As reported in the ELECTRICAL WORLD for March 10, page 591, the Federal Power Commission has awarded a preliminary permit for developing power at High Dam, in the Mississippi between St. Paul and Minneapolis, to Henry Ford, subject to certain stringent conditions which he must accept before receiving a license. While awaiting final disposition of the matter a joint committee of the Engineers' Club of Minneapolis and the Engineers' Society of St. Paul has made a report in which it says that "the one logical agency for the development and proper utilization of the power developed at the High Dam is the Northern States Power Company." At another point in its report the joint committee says:

"If the coming of the Ford interests to the Twin Cities is contingent upon their having the initial use of the High Dam power, this is another method of immediate utilization of this power, and your committee would favor an award to the Ford Motor Company by the Federal Power Commission, provided that an arrangement for disposing of any excess power not required by the Ford Motor Company is made with a distributing agency. The committee further feels that the public's interests are entirely guarded whether the permit for the High Dam power is awarded to the Northern States Power Company or to the Ford interests because of the fact that the United States government through its Federal Power Commission has full and complete authority as to construction, operation and rates to be charged, no matter who develops and operates a water-power project under a federal grant."

In regard to the development and operation of the High Dam by the city of Minneapolis, the committee is unanimous in its opinion that "the hazard of an investment such as is contemplated is far too great and entirely unwarranted for so small an anticipated saving." The committee also expresses the opinion that "the development of the High Dam by the municipalities will have no effect whatsoever on the stabilization of public utility rates for lighting or power purposes, for the cost of producing electrical energy at the switchboard is only a small factor of the total cost of furnishing this energy to users."

Eleven States Ratify Reciprocal Registration

For the purpose of making operative the reciprocal registration of professional engineers in the various states, several state boards of engineering examiners, which are members of the Council of State Boards of Engineering Examiners, have agreed to adopt and put in practice provisions to that end. So far, according to P. H. Daggett, secretary-treasurer of the council, eleven states have ratified reciprocal registration, namely, Arizona, Colorado, Florida, Indiana, Iowa, Louisiana, Michigan, Minnesota, North Carolina, Oregon and West Virginia. Wyoming and South Carolina are expected to take similar action this month.

The "Articles of Agreement on Reciprocal Registration of Engineers" contain the following provisions:

"Reciprocal registration shall be granted only to an applicant who is already licensed in a state which is a member of this council. A detailed professional record, properly attested, and accompanied by references as to character and qualifications from three registered practicing engineers, shall be filed with the board of registration of

the state in which the applicant is originally licensed.

"Professional experience shall be considered as beginning when the applicant shall have entered upon a position in professional engineering work which requires original thought and responsibility.

"As evidence of qualification for reciprocal registration, the applicant shall have had ten years of experience in professional engineering and in addition shall show that he is qualified to design as well as to direct engineering operations, and his experience record shall show progressive advancement in the character of the work performed.

"Graduation from an engineering school of recognized standing shall be accepted as equivalent to four years of practice.

"Reciprocal registration between states shall be made operative by means of certification of the applicant's qualification from one state to another. This certification shall be by means of a card or form bearing the date, serial number, signature of the officers and seal of the board of the state issuing same. These cards shall be printed and distributed by the Council of State Boards of Engineering Examiners."

Colorado River Projects and Others

Despite Delay of Treaty, Power Commission May Act on Diamond Creek and Glen Canyon—Cumberland River Rights Sought—White River Development

WHETHER or not the Federal Power Commission will be content to allow the failure to ratify the Colorado River compact to delay indefinitely all development on the Colorado River probably will be determined at a meeting of the commission to be held April 18. The commission has advised the Governor of Colorado, according to a previous promise, that consideration is to be given the application of James B. Girand for a license to develop the project at Diamond Creek on the Colorado. It was stated in the letter to the Colorado Governor that any license issued to Mr. Girand would carry with it a condition that the use of the water for power purposes would have to be subordinated to its use for irrigation.

This carries with it the intimation that the commission may act on the Girand application at its forthcoming meeting. It is understood that Mr. Girand will accept the condition mentioned. The controversy over the project at Diamond Creek has been long drawn out. Mr. Girand received a permit covering this project in 1915 and has been trying ever since to obtain the necessary rights to begin construction.

It is fully expected, however, that the discussion will include the whole Colorado River question. Any discussion of the Diamond Creek project carries with it the necessity of considering the Glen Canyon application of the Southern California Edison Company. It also is believed that the Flaming Gorge project of the Utah Power & Light Company will be brought up, since that company is very anxious to utilize the coming field season to do the necessary drilling to establish foundation conditions. The Kremmling project of the Denver Gas & Electric Light Company is also to be considered.

SODA POINT DAM

Permission has been given the Utah Power & Light Company to alter again the exact site of its Soda Point dam. Permission was granted previously to change the site from the original location to a point 1,200 ft. up stream. Further foundation investigations revealed that better conditions exist at a point 700 ft. above that point.

The Michigan Hydro-Electric Power Company of Three Rivers, Mich., affiliated with the Midwest Power Company, has applied for a preliminary permit covering a project on the St. Joseph River near Three Rivers. It is planned to develop 2,500 hp. The company is prepared to begin its development immediately.

The Midwest company also is planning a development on the Grand River, northeastern Oklahoma. The company operates public utilities in several towns in that region. The new power is to be fed into those systems.

FALLS OF THE OHIO AND WHITE RIVER PROJECTS

The Cumberland Hydro-Electric Power Company, recently organized in Indianapolis, which holds options on valuable Cumberland River rights in southeastern Kentucky, has applied to the commission for preliminary permits covering three projects on that stream. The Cumberland company has entered into a contract with the Middle West Utilities Company of Chicago with the idea of carrying out the Kentucky development, which is an important adjunct to the utilization of the power to be developed by the new government dam at the Falls of the Ohio. The Middle West company has properties in Kentucky and in Indiana which are in a position to absorb the power thus to be made available.

Full development of the Cotter site on the White River, in Arkansas, is to be undertaken by a company being organized by Hugh L. Cooper. The interests of the Dixie Power Company in this project already have been taken over by Colonel Cooper. The project contemplates the erection of a dam 215 ft. high. An extensive pool will be created which will reach up the river as far as Forsyth, Mo. In addition, sites are to be developed on the North Fork and the Buffalo Fork of the White River. The total development will create 125,000 hp. The possibilities of this site long have been recognized. For ten years prior to the passage of the water-power act determined efforts were made to secure authorization from Congress for the development. It was one of those projects which were caught in the long period of uncertainty which preceded the final enactment of the water-power act.

Water Power in Maine

Conservation Program Is Defeated by the Governor's Attitude and the Disagreement of Legislators

PLANS for the development of a storage reservoir for hydro-electric and other water-power conservation in the Dead River and Kennebec River valleys of Maine failed to materialize at the session of the Legislature which closed April 7 and which was marked by sharp divergences of opinion between Governor Baxter, the members of the two houses and the public utility and manufacturing interests interested in furthering the cause of conservation. During the session the controversy over this issue overshadowed practically all other matters at the Capitol. General agreement exists as to the necessity for storage-reservoir construction on the Dead River, and the well-known opposition of the Governor to private ownership of water-power facilities under public regulation appears to have been the chief factor in the failure of a constructive measure to become law.

Early in the session a bill was introduced authorizing the incorporation of the Kennebec River Reservoir Company for the construction of a dam on the Dead River on land owned by the state. It was provided that the amount to be paid for the land should be determined by arbitration. Governor Baxter vetoed the bill, and the veto was overridden by a two-thirds vote. The Governor then appealed to the people to defeat it by a referendum, the vote to be taken at the regular election in September, 1924. The public utility and manufacturing interests which were asking for the charter met this issue by circulating petitions demanding a special election so that the question might be settled this year. The Governor followed by a message to the Legislature stating that a compromise had been reached by which a new developing corporation (the Dead River Reservoir Company) would pay the state $1,000,000 rental for the right to use the land and resources involved, in forty annual payments of $25,000 each.

The compromise bill was never introduced, but so much confusion and cross-purpose action ensued that the Legislature finally repealed the original act, thus annihilating the hope of conservation in the Kennebec and Dead River valleys at this time. As the Maine constitution would have to be amended to enable state development of water powers to be attempted, there appears no present danger of progress toward public ownership; but in the meantime power users will be obliged to suffer a continuance of handicaps through

water shortages in competition with other conservation developments in Maine and elsewhere, and a deplorable waste of power will go on as a result of the fiasco with which the session closed.

Indianapolis Companies Show Rapid Growth

An increase of between 28 and 30 per cent in the production and sale of electrical energy used for lighting and power purposes in 1922 over the preceding year is indicated in the annual statements for the year ended Dec. 31 made by the two light and power utilities of Indianapolis and filed with the Indiana Public Service Commission. The financial statements of the Indianapolis Light & Heat Company and the Merchants' Heat & Light Company both reveal a comfortable margin of gross income as a result of the year's business, due in the main to the increase in electric power used by the industrial companies of the city. The rate of increase in energy generated and sold for the first two months of this year is even greater than that for the corresponding period of 1922, being estimated at 40 to 50 per cent.

According to the financial statement of the Indianapolis Light & Heat Company, total operating revenues from all sources for the year 1922 were $3,910,120 and operating expenses were $3,051,364. The gross income came to $887,251. After deducting interest charges on the funded debt and taxes, there was total net income for the year of $678,138. The total amount of electrical energy generated during the year, the report shows, was 138,356,280 kw.-hr.

The total kilowatt-hour production of energy by the Merchants' Heat & Light Company for 1922 was 80,094,318. Total earnings of the company from the sale of energy were $2,064,833 and operating expenses were $1,425,810. There was a gross income from lighting and power of $660,811. Total commercial lighting revenues were $642,356, representing the sale of 11,977,988 kw.-hr.; municipal contract lighting revenues were $305,482, and commercial power earnings were $892,982. Revenues from sale of energy to other utilities totaled $224,014. Total merchandise sales were $41,283, showing net profits of $7,599.

Iowa May Tax Water-Power Plants 10 Cents per Hp.

A committee of the Iowa lower house has had under consideration a bill which provides for the issuance of permits for the construction and operation of dams and the imposition of a $100 original permit fee and an annual privilege tax of 10 cents per theoretical horsepower. The permit fee would be required for dams now constructed as well as those to be constructed in the future, and the occupational tax would be levied on all dams and water-power plants built after the enactment of the law. Permits would be required for all except municipal dams. Sections to prohibit unlawful combinations and price fixing of the output of any dam under heavy penalties are contained in the bill, which has been drawn up along lines recommended by Governor Kendall in a message to the Legislature.

Brief News Notes

A. S. M. E. Seeks Postponement of Law for Registration of Engineers.—The American Society of Mechanical Engineers is attempting to obtain a postponement of the law in New York State requiring the registration of all engineers in the state by May 5, 1923, and the New York membership of the society is being circularized to learn the opinion of mechanical engineers on the various phases of the law.

Wireless-Telephone Record.—What is said to be a new distance record for wireless telephony over a high-voltage transmission line was established when the Lake Superior District Power Company talked 42 miles from its branch at Ashland, Wis., to its Ironwood (Mich.) branch. The company expects to use the system extensively for communication between its plants in the northern parts of the two states.

Marshfield Sticks to Municipal Plant.—Following the example of Manitowoc, Wis., the city of Marshfield, in the same state, has resolved to increase the equipment of its municipal plant and has discontinued negotiations looking to the connection of the city with the high-power lines of either the Wisconsin Valley Electric Company of Wausau or the Wisconsin-Minnesota Light & Power Company of Eau Claire. New equipment will be purchased from the Allis-Chalmers and Westinghouse companies.

Daylight Saving as a Crime.—Amid news of the usual legislative struggles in early spring between advocates and opponents of daylight saving stands out the passage of a bill by the lower house of the Connecticut Legislature imposing a fine of $100 or a sentence of ten days in jail for the "willful public display of any time-measuring instrument or device intentionally set so as to indicate any time other than standard time." Fortunately the Draconian spirit in which a predominantly bucolic House approached the problem was emulated in the Senate, which has left daylight saving as it found it.

Utica Company to Extend Use of Carrier Current.—The Utica Gas & Electric Company plans to extend the carrier-current wireless-telephone system it has now in use between its Trenton Falls plant and Utica so as to include the Rome and Watertown plants. The installation by the General Electric Company has been particularly successful, the company reports, and since Dec. 7, when the system was first put in use, only one suspension of communication has been forced. The Utica company was a pioneer in the use of carrier current for interplant communication.

First Electrically Driven Passenger Boat for Great Lakes.—The Goodrich Transit Company announces that plans have been completed for the construction by the Manitowoc (Wis.) Shipbuilding Company of the first electrically driven passenger boat on the Great Lakes. It will go into service next season between west short ports of Lake Michigan. The vessel will be from 345 ft. to 360 ft. long, will contain 300 rooms above decks with 600 berths, and the cost is estimated in the neighborhood of $1,000,000. No decision as yet has been made as to the exact type of equipment to be installed.

Forty-two Thousand Persons Go Through Tunnel.—Upward of forty-two thousand persons went through the power tunnel of the Niagara Falls Power Company during the week that it was open for public inspection prior to admitting the water. The average was 500 persons each hour that the tunnel was open. Many engineers and scientific men came from a distance to examine the project. Among the visitors were the entire senior class of the University of Kentucky's school of engineering. The new tunnel is one mile in length and 32 ft. by 32 ft. in diameter.

Johns Hopkins Engineering Lectures.—The first of the open lectures on engineering practice given each year at Johns Hopkins University, Baltimore, was delivered on Wednesday of this week on a civil engineering topic. Two others will follow—the first on Wednesday, April 18, when N. W. Storer, general engineer with the Westinghouse Electric & Manufacturing Company, will consider the "Possibilities for Steam Railroad Electrification," and the second on Monday, April 30, when George A. Orrok, consulting engineer, New York City, will discuss "Power Development, Past and Future."

Wisconsin Utilities to Spend $25,000,000 This Year.—Basing his estimate on the returns of a questionnaire sent out by the Wisconsin Public Utilities Bureau, J. P. Pulliam, the retiring president of the Wisconsin Utilities Association, said in his address at the recent meeting of that body that the utilities of Wisconsin would spend between $25,000,000 and $30,000,000 during 1923 for additions, extensions and improvements to their plants and outside equipment. Among the larger expenditures he listed were $6,860,000 by the Milwaukee Electric Railway & Light Company and the Wisconsin Gas & Electric Company, $1,500,000 by the Wisconsin Public Service Corporation, $925,000 by the Wisconsin Power, Light & Heat Company and $700,000 by the Lake Superior District Power Company.

Hydro-Electric Project to Serve Petrograd.—An 80,000-hp. hydro-electric plant, situated east of Petrograd on the Volchov or Wolko River, is under construction, according to Max

Kadinsky, a Russian engineer who is a graduate of the University of Illinois. Eight vertical turbines with a capacity of 10,000 hp. each under a head of 40 ft. will make up the installation. The average yearly output, estimated at 40,000 hp., will be transmitted to Petrograd, a distance of about 80 miles, at 110,000 volts. The power house will be a reinforced-concrete building and the dam of masonry type. Work already done includes about one-third of the excavation for a canal connected with the project, a part of the caissons which must be sunk for the power house and an ice-diversion wall.

Growth of Load Will Force Rapid Expansion of Cahokia Plant.—A probability that when the Union Electric Light & Power Company of St. Louis completes the first unit of its new Cahokia power plant on the east bank of the Mississippi River next autumn it will within a few weeks begin construction of the second of the four ultimate units was forecast by Louis H. Egan, president of the company, in a recent address. It had been thought that the second unit would not be undertaken before two years, but the rapid increase in consumption in the St. Louis district will force the company to accelerate its plans, and the entire construction, which it was intended to spread over ten years, may be accomplished in five or six.

May Generate Electricity from Sewage-Disposal Plant.—A possibility that Milwaukee will generate the energy for its street-lighting system in the sewage-disposal plant under construction for the city on Jones Island, instead of obtaining the power from the Milwaukee Electric Railway & Light Company, as it does now, exists, if the report of T. C. Hatton, chief engineer of the sewage-disposal commission, may be taken at its face value. The sewage-disposal plant is to be finished next year, and Mr. Hatton says: "The maximum capacity of the boiler plant is 6,200 hp., but when two boilers are operating at a 20 per cent rating they can produce all the power required up to 1930 for the street-lighting needs of this city unless the city decides to install generators for producing current for street-lighting purposes." This is interpreted to mean that only two boilers will be needed to dispose of the sewage and that the other two which are to be installed will await only the installation of generators by the city to furnish energy for the street-lighting system.

Oversea Telephony.—As an outcome of the recent successful demonstration of wireless telephony between New York and London, the British Postmaster General has appointed a committee "to consider in the light of recent progress in the wireless science the possibilities from a technical standpoint of transatlantic wireless telephony of sufficient reliability for commercial use and to advise what practical steps, if any, can at present be taken to develop this means of communication." A beginning of commercial service is, however, according to American authorities, at least twelve months and probably twice that time away. Ignorance of the precise nature of atmospheric changes, which make talking easier by day than by night and harder in summer than in winter, is a hampering factor. The prospect is that much more powerful broadcasting apparatus will have to be used in the summer than that which so far has been used in successful experimental demonstrations. Another great difficulty, and one which makes official activity by Great Britain particularly desirable, is that the present English telephone circuits are not adaptable to relaying wireless messages to or from the coast, so that improvement of the present apparatus in use on land lines in England is essential to commercial communication.

Associations and Societies

Nebraska Section, N. E. L. A.—The annual convention of this section, which forms part of the Middle West Geographic Division of the association, will be held on Thursday and Friday, May 10 and 11, at Omaha.

Engineering Council of Utah to Give Banquet.—The annual banquet of the Engineering Council of Utah has been set tentatively for April 23 at the Hotel Utah, Salt Lake City. Calvin W. Rice and other prominent engineers are expected to speak.

Associated Manufacturers of Electrical Supplies.—The summer section meetings of the Associated Manufacturers of Electrical Supplies will be held at the Hotel Griswold, Eastern Point, New London, Conn., beginning Tuesday, June 26, and extending through the week. On June 28 the annual meeting of the association will be held.

American Welding Society.—The annual meeting of this society will be held at the Engineering Societies Building, New York, from April 24 to April 27. The committees on training of operators, resistance welding, electric arc welding and welding of storage tanks will report on the first day. New developments in the welding field will be discussed on the second day, W. L. Warner reporting on electric welding.

Coming Section Meetings of A. I. E. E.—Section meetings of the Institute to be held next week are announced as follows: Baltimore, April 20, "Insulator Design and Manufacture," K. A. Hawley; Boston, April 16, "The Panama Canal," Brig.-Gen. Chester Harding, U. S. A.; Cleveland, April 19, "Manufacture of Copper Wire and Cable," C. F. Hood; Seattle, April 18, "The Columbia Basin Project," W. T. Batcheller.

Tri-State Water and Light Association.—Birmingham technical men are getting ready for the annual convention of the Tri-State Water and Light Association, which will be held in that city on April 17, 18 and 19. On the first day Glen H. Corlette of the engineering department of Fairbanks, Morse & Company, Atlanta, will speak on "The Oil Engine as a Prime Mover and Its Application to the Electric Plant"; A. A. Passolt, manager of the water and light plant at Newnan, Ga., will talk on "How Experience Guides Us in Looking Ahead," and there will also be short talks on Birmingham industries and the Alabama Power Company. Speakers selected for the second day include C. N. Grantham, city manager, Goldsboro, N. C., who will talk on "Service-Satisfying the Consumer," and E. T. Austin, General Electric Company, Atlanta, whose subject will be "Development of Street Lighting." Another speaker will be L. V. Gaffney, superintendent of the municipal plant of Gaffney, S. C., whose topic will be "Management in Easing the Day Load."

Coming Meetings of Electrical and Other Technical Societies

[A complete directory of electrical associations is published in the first issue of each volume. See Jan. 6 issue, page 78, for latest list.]

American Society of Mechanical Engineers—Pacific Coast meeting, Los Angeles, April 16-18; general convention, Montreal, May 28-31. C. W. Rice, 29 West 39th St., New York.

Tri-State Water and Light Association—Birmingham, April 17-20. W. F. Steiglitz, Columbia, S. C.

American Physical Society—Washington, April 21. D. C. Miller, Case School of Applied Science, Cleveland.

American Institute of Electrical Engineers—Spring convention, Pittsburgh, April 24-26; annual convention, Swampscott, Mass., June 25-29; Pacific Coast convention, Del Monte, Cal., Sept. 25-28. F. L. Hutchinson, 33 West 39th St., New York.

American Welding Society — New York, April 24-27.

American Electrochemical Society — New York, May 3-5. Colin G. Fink, Columbia University, New York.

Nebraska Section, N. E. L. A.—Omaha, May 10-11. Horace M. Davis, secretary-treasurer.

Southwestern Public Service Association—Fort Worth, Tex., May 15-17. E. N. Willis, 403 Slaughter Bldg., Dallas, Tex.

Empire State Gas and Electric Association, Electric Section—Utica, N. Y., May 17-18. C. H. B. Chapin, Grand Central Terminal, New York.

Electrical Supply Jobbers' Association—Executive committee and general meeting, Hot Springs, Va., May 21-25. Franklin Overbagh, 411 S. Clinton St., Chicago.

Missouri Association of Public Utilities—River boat from St. Louis to Peoria, May 24-26.

National Electric Light Association—New York, June 4-8. M. H. Aylesworth, 29 West 39th St., New York.

California State Association of Electrical Contractors and Dealers—Dorner Lake, Cal., June 9-16.

Electric Power Club — Hot Springs, Va., June 11-14. S. N. Clarkson, Kirby Bldg., Cleveland.

North Central Division, N. E. L. A.—Minneapolis, June 13-15. H. E. Young, Minneapolis General Electric Company.

Pacific Coast Electrical Association—San Francisco, June 19-22. S. H. Taylor, 527 Rialto Bldg., San Francisco.

Society for the Promotion of Engineering Education—Ithaca, N. Y., June 20-22. Dean F. L. Bishop, University of Pittsburgh.

Canadian Electrical Association — Montreal, June 20-23. Louis Kon, 65 McGill College Ave., Montreal.

American Society for Testing Materials—Atlantic City, June 25-29.

National Council Lighting Fixture Manufacturers—Hot Springs, Va., June 26-28.

Northwest Electric Light and Power Association—Seattle, June 27-30. G. E. Quinan, 204 Electric Bldg., Seattle.

Ohio Electric Light Association — Cedar Point, July 10-13. D. L. Gaskill, Greenville.

Recent Court Decisions

Company Cannot Be Sued Under Employers' Liability Act for Death of a Non-Employee.—In Saylor vs. Enterprise Electric Company, the Supreme Court of Oregon has sustained the lower court in holding that an electric service company cannot be sued under the employers' liability act of the state because of the death of a man, not an employee, through contact with a high-tension line of the company brought about when he moved a hay derrick from one field to another. Only employees can prosecute under this act, and decedent's widow, if entitled to redress, must seek it otherwise and defendant will be entitled to plead contributory negligence as a defense. (212 Pac. 477.)*

United States Supreme Court Upsets Minimum-Wage Law.—By a divided court, five to three, the United States Supreme Court on April 9 declared the minimum-wage law passed by Congress for the District of Columbia unconstitutional as abridging the right of contract guaranteed by the Fifth Amendment to the Constitution. The decision was by Justice Sutherland, with whom concurred Justices McKenna, Van Devanter, McReynolds and Butler. Chief Justice Taft and Justice Sanford joined in one dissenting opinion, while Justice Holmes read a more sweeping dissenting opinion. Justice Brandeis, whose daughter is secretary of the District of Columbia Minimum Wage Board, did not participate in the case or in the opinion. The decision has national significance, establishing a precedent for tests of minimum-wage laws of thirteen states. The Attorneys-General of New York, California, Kansas, Oregon, Wisconsin and Washington intervened in the case, presenting briefs in support of the constitutionality of the act. The District of Columbia minimum wage law applied to women and to minors. The District Supreme Court declared the law valid. The Court of Appeals first upheld this decision, but on rehearing reversed it.

What Is Ordinary Care in Case of Accident Arising Through Tree Climbing?—In Godfrey vs. Kansas City Light & Power Company damages were awarded for serious injury to a boy who climbed a walnut tree on a vacant lot and came into contact with an electric power wire. Although the boy was a trespasser as to the owner of the land, he was not a trespasser as to the company, the Kansas City Court of Appeals declared in affirming the verdict, and the company was not relieved by his trespass of the duty to use ordinary care and anticipate reasonably likely occurrences. An instruction denying recovery if the boy knew or could have discovered by any means that there was a dangerous wire in the vicinity of the tree climbed was properly refused, the court held, since it wholly ignored the question of ordinary care; nor was an instruction directing a verdict for the plaintiff if the wire was uninsulated and could have been insulated and made harmless erroneous as imposing a greater burden than that of exercising reasonable care. These and similar instructions did not give the jury a "roving commission" to find the defendant guilty of negligence, nor was any question of law thereby submitted to it. (247 S. W. 451.)

*The left-hand numbers refer to the volume and the right-hand numbers to the page of the National Reporter System.

Commission Rulings

District Commission Maintains Income Tax Ruling and Champions Historical Valuation.—The Public Utilities Commission of the District of Columbia has ordered a reduction in the rates of the Potomac Electric Power Company. This reduction is in addition to the one ordered a year ago and designed to provide at least a 7 per cent return. As a matter of fact, the commission finds, the rate of return for 1922 was 8.9 per cent. The hearing was held on the initiative of the commission. The company asked that no change be made in its existing rates pending the final decision in the valuation case then before the United States Supreme Court. The Federation of Citizens' Associations of the District of Columbia urged the commission to state "clearly and definitely its treatment of the depreciation fund account and the federal income tax item of said company" and protested against "the practice of the commission of the allowance in full and their addition to the valuation base established in 1916, at book value, of all property additions made by the company since the commission's valuation of the year named." As to the federal income tax, the commission adhered to its position in previous cases that such taxes should be borne by the corporations and not passed on to the public—"should not be included as an operating expense, but should be paid from the net income of the company." The commission made an analysis of the depreciation account, saying that the reserve was growing rapidly to such a size that it would be necessary to give careful consideration at an early date to the manner in which it should be treated. The commission took exception to the statement of the federation that the property to the value of $7,000,000 added since its valuation order of 1916 had "never been appraised, valued or passed upon in review by the commission." "There is no better method of valuation known," it said, "than the ascertainment of the actual cost of property where such cost represents the investment honestly and prudently made. The commission believes this to be the most exact possible kind of valuation and in accordance with the provisions of the public utilities act. This position of the commission was clearly stated at the public hearing on the rates of the Potomac Electric Power Company held July 18, 1921, at which time the representative of the Federation of Citizens' Associations advanced the same argument on this question. To the commission it appears difficult to believe that the argument is intended to be taken seriously."

Rates Should Be Large Enough to Insure Good Service.—In fixing new rates for the Potomac Electric Power Company the District of Columbia commission said: "The rates now in effect in the District of Columbia are reasonable and compare favorably with those in effect in other large cities where power plants operated by steam are in use. What is desired by all is good service and this implies dependability as well as reasonable rates. To insure dependability, and for the business man particularly this is the first consideration, it is necessary that the company shall always be in a position to keep the capacity of its plant well in advance of the demand upon it. To insure economy in generating energy, it is necessary that the company shall keep well abreast of progress in the mechanical and electrical arts, installing new and improved appliances promptly when their worth has been demonstrated. To do these things the company must be able to raise funds in comparatively large amounts. To enable this money to be secured at reasonable rates, if at all, requires that the company shall have good credit. It is therefore in the interest of the entire public that rates be not reduced so low as to prevent that healthy growth of the company's facilities without which the entire community might suffer serious losses and inconvenience of various kinds. The commission does not therefore believe a return of 7.99 per cent more or less to be excessive, but it is nevertheless of the opinion that the circumstances of this case warrant a reduction in the present rates of the Potomac Electric Power Company and that this reduction will not impair the company's credit or its ability to serve the public."

Construction Costs and Overhead Expense Under Pioneering Conditions.—In its valuation of the property of the Idaho Power Company, the Idaho Public Utilities Commission held that the use of average prices over the period from 1913 to 1916 for the study of property placed in service prior to 1917 and the actual cost of property installed after that time was fair to both the utility and the public. An allowance of 10½ per cent was made for general overhead expenses, exclusive of interest during construction, in valuing this utility, which was constructed under pioneer conditions.

Men of the Industry

Changes in Personnel
Accomplishments, Responsibilities, Honors, Appointments and Activities of Men Engaged in all Branches of the Electrical Industry

W. B. McKinley and C. Studebaker Head New Company

William B. McKinley, who has been president of the Illinois Traction Company, will be chairman of the board of the Illinois Power & Light Corporation, which is acquiring an extensive group of long-established utility properties and which will control the Illinois Traction, Inc., through ownership of the entire capital stock of that company. The president of the Illinois Power & Light Corporation will be Clement Studebaker, Jr., who with his associates, through the medium of the North American Light & Power Company, is acquiring a controlling interest in the company. Mr. Studebaker is chairman of the board of the North American Light & Power Company. Among the directors of the Illinois Power & Light Corporation in addition to Mr. McKinley and Mr. Studebaker will be William A. Baehr, H. E. Chubbuck, George Mattis and G. W. Niedringhaus.

Dr. Hollis to Leave Worcester "Tech"

Dr. Ira N. Hollis, for the past ten years president of the Worcester (Mass.) Polytechnic Institute, distinguished for his service in the navy and as an educator at Harvard University, has presented his resignation to the board of trustees, to take effect upon the appointment of a successor. Dr. Hollis was born at Mooresville, Ind., in 1856 and was graduated from the United States Naval Academy in 1878. For twenty years previous to his association with the Worcester Polytechnic Institute he had been professor of engineering at Harvard. He is widely known in educational and engineering circles and his philosophical views of the trend of science and economics command a wide audience. Upon retirement from the Worcester institution Dr. Hollis plans to engage in literary work.

William Lamont Abbott, the chief operating engineer of the Commonwealth Edison Company, Chicago, has been selected to head the special committee of the Federated American Engineering Societies which will make a study of coal storage. Mr. Abbott has long been a student of coal storage.

Charles E. Wiggin, manager of the electrical department of the Dunham, Carrigan & Hayden Company since 1910, has resigned to join the sales force of the Pacific States Electric Company. Mr. Wiggin is well known in electrical jobbing circles of the West.

P. O. CRAWFORD

P. O. Crawford and W. M. Shepard Made Vice-presidents

At a recent meeting of the board of directors of the California-Oregon Power Company Perry O. Crawford, chief engineer of the company, was made vice-president and chief engineer and W. M. Shepard, general agent, was made vice-president and general agent.

Mr. Crawford received his technical training at Stanford University and took an A.B. in electrical engineering from that institution in 1908. During the next three years he was construction engineer for the Northern California Power Company and built several power plants. In 1912 he went to Afghanistan as assistant engineer on government hydro-electric work and for three years was in charge of the construction of the Jabl-us-siraj power plant. After returning to the United States he spent six months at Stanford University in research work under Prof. Harris J. Ryan. He became identified with the California-Oregon Power Company in 1916 and since that time has had charge of all engineering activities of that company, including the building of Copco dam and power house and several important transmission lines.

W. M. SHEPARD

Mr. Shepard was graduated from the Alabama Polytechnic Institute in 1904, and then spent about a year with the Knoxville & Northern Railroad. In 1905 he took the General Electric test course and in 1906 was transferred to the Atlanta office of the company and later to the San Francisco office. While with the General Electric Company in San Francisco he worked successively as supply salesman, apparatus salesman and special agent and was active in applying electricity to gold dredging and other typically Western industries. He joined the California-Oregon Power Company in 1916 as commercial agent and became general agent in 1918. He has had charge of all commercial activities of this company since his affiliation with it, including the negotiation of interconnection agreements with other power companies, and in addition has been in charge of valuation work and rate matters of the company.

E. S. Roberts, assistant commercial manager Blackstone Valley Gas & Electric Company, Pawtucket, R. I., has resigned to enter private business. Mr. Roberts has been active in the Commercial Section of the New England Division, N. E. L. A., and has done excellent work in the field of public relations.

E. J. Seaborn, formerly assistant treasurer of the Truckee River Power Company, has been transferred to Houston, Tex., as assistant treasurer of the Houston Electric Company and the Galveston-Houston Electric Railway. Mr. Seaborn has been with Stone & Webster for sixteen years and was with the Truckee River Power Company for five years. He is taking the place vacated by the transfer of H. L. Harding to Boston, where he will be in the treasurer's department of Stone & Webster.

G. C. Neff, Madison, Wis., was elected vice-president in charge of operation of the Wisconsin Power, Light & Heat Company, the Wisconsin River Power Company, the Southern Wisconsin Power Company, the Eastern Wisconsin Electric Company and the Mineral Point Public Service Company, all subsidiaries of the Middle West Utilities Company, at a recent meeting of the boards of directors of the above-named companies. These companies operate the large hydro-electric plants on the Wisconsin River at Kilbourn and Prairie du Sac. Mr. Neff is also treasurer of the Wisconsin Utilities Association and chairman of the rural-lines committee of the National Electric Light Association.

R. E. Smith Electric Club's President

Richard E. Smith, advertising manager of the Southern California Edison Company, has recently been elected president of the Electric Club of Los Angeles. Mr. Smith has been engaged in the electrical industry in California for the past seventeen years. Starting as a wireman's helper in San Diego, he has held successively the positions of Pacific Coast representative of the National X-Ray Reflector Company, illuminating engineer of the Pacific Light & Power Company, sales manager of the Mount Whitney Power & Electric Company, district manager of the Tulare office, Southern California Edison Company, and, for the past two years, advertising manager of the Southern California Edison Company. He has been one of the oustanding figures in the club during the two years of its existence. His contributions to *Sparks*, the club's weekly bulletin, early earned for him a large and loyal following, and this, together with committee work and the directing of programs, has culminated in his election to the highest office in the club.

William Dubilier, president of the Dubilier Condenser & Radio Corporation, New York City, has just returned from Europe after spending a month visiting England, France, Germany and Belgium.

C. B. Merrick, who recently spent several months with the Valley Electric Supply Company of Fresno, Cal., is now back with the San Joaquin Light & Power Corporation as assistant to the new-business manager.

Rudyard Goodland, who has been assistant superintendent of the Oliver mine at Ironwood, Mich., for several years, has recently been made superintendent of distribution of the Wisconsin Gas & Electric Company.

W. T. Leander replaces W. H. P. Weston as secretary and treasurer of the Ironwood & Bessemer Railway & Light Company, and W. J. Hodgkins, formerly purchasing agent, is now general manager and has been succeeded in the position of purchasing agent by L. G. Gothe. J. B. O'Neil, formerly line superintendent, has become district manager, supplanting E. L. Hinchliff; E. O. Sinrud replaces W. A. Campbell as assistant district manager, and R. S. Wilhelm, formerly engineer of power station, has become chief engineer.

Frank D. Schwartz has resigned as Western salesman of the Indiana Rubber & Insulated Wire Company. Mr. Schwartz was formerly sales manager of the Electric Appliance Company, Chicago, and has long been a prominent figure in the rubber-covered-wire industry. For the last nine years he has had sales direction for the Indiana Rubber & Insulated Wire Company over the State of Ohio and all territories south and west. Mr. Schwartz has announced no definite plans for the future, but will remain in Chicago as his home is in Oak Park. F. R. Dolan has been appointed Chicago representative for the Indiana Rubber & Insulated Wire Company.

O. H. Simonds Leaves Dubuque

O. H. Simonds, vice-president and general manager of the Dubuque (Iowa) Electric Company, has resigned to ally himself with the Electric Bond & Share Company of New York City. Mr. Simonds has been identified with the electrical industry since 1908, when, after being graduated from Cornell University, he joined the forces of the General Electric Company. For seven years thereafter he was employed in various capacities with that company, spending the last four in the lighting and railway department of its Chicago office. He then resigned to enter the

O. H. SIMONDS

engineering department of Elston, Clifford & Company, Chicago, and later became general manager of the Vicksburg (Miss.) Light & Traction Company. Since his advent in Dubuque as general manager more than five years ago, Mr. Simonds has been able to advance materially the interests of the properties intrusted to his management. The Electric Bond & Share Company of New York watched with interest the results of his efforts and has been desirous of obtaining his services for about two years. Recently the inducements were made so attractive that his satisfaction with his Dubuque position had in the exercise of sound business judgment to be subordinated. He will be stationed in New York.

Mr. Simonds has been active in state association work and also in committee work of the N. E. L. A. and in addition has found time to devote to movements tending to civic improvement and advancement. His successor will be Thomas Parker, who comes from the Emporia (Kan.) division of the Kansas Power Company, owned and controlled by the Albert Emanuel Company.

R. C. Hodges, formerly chief electrical engineer with the Newburgh (N. Y.) Shipyards, Inc., has opened offices in Newburgh, specializing on power installation.

C. L. Marshall of the Tacoma office of the Puget Sound Power & Light Company has been transferred to the Wenatchee office of the Washington Coast Utilities. Z. E. Merrill, electrical superintendent at Wenatchee, who resigned, has been succeeded by Frank Walsh of Everson.

William W. Merrill, who has been associated with the Chicago Fuse Manufacturing Company since 1894, was recently elected president of the organization, succeeding Arthur D. Dana, retiring to become chairman of the board. Mr. Merrill has served successively as bookkeeper, cashier, secretary, assistant treasurer, treasurer, and since April, 1910, as vice-president and general manager.

Thomas W. Peters, who has been general superintendent of the Potomac Public Service Company, with headquarters in Frederick, Md., for nearly a year, has resigned. Mr. Peters resigns to join the American Water Works & Electric Company and will become the general superintendent of the Cumberland Edison Company, a property recently acquired by the American company. William C. Humm will succeed Mr. Peters at Frederick.

E. A. Bradner, newly elected president of the New Mexico Public Utilities Association, has been identified with public service corporations for more than thirty years. Starting as an arc-light trimmer, he has held all intermediate positions up to that of manager, which office he now occupies with the Las Vegas Light & Power Company and the Las Vegas Transit Company. For a number of years Mr. Bradner was chief engineer and superintendent of the Grays Harbor (Wash.) Railway & Light Company and later became manager of the central station at Hobart, Okla., holding this position until 1919.

John W. Carpenter, vice-president and general manager of the Texas Power & Light Company, with head offices in Dallas, was elected president of the Southwestern Geographical Division of the National Electric Light Association at the convention held recently at Oklahoma City. Mr. Carpenter has been identified with the electrical industry in the Southwest for the last twenty-five years. He entered the business in Corsicana and his rise has been steady and rapid. To Mr. Carpenter is given credit for having launched the recent campaign in Texas looking to the establishment of cotton mills, and it was due to his efforts that nationally known textile engineers visited Texas and made investigations which have already resulted in the organization of a half-dozen companies for building cotton mills. Mr. Carpenter has also been deeply interested in industrial education in Texas, and Governor Neff recently appointed him as one of the members of the first board of trustees of the new Texas Technological College to be founded in west Texas.

Manufacturing and Markets

Devoted to the Discussion of Business and Economic Problems of the Producer and Distributor, with Market Reports, Trade Activities, Foreign and Construction News

A Quota Plan for Jobbers' Salesmen

Report on Some Recent Experience in Setting a Sales Bogey in Each Community and by Commodities

By H. F. Thomas

President Northwestern Electric Equipment Corporation, St. Paul

FOR a long time we have felt that we were considerably handicapped by the fact that our salesmen—like other jobbers' salesmen—have been working in the dark. That is, they have been going on from day to day and from town to town, taking orders for what commodities they could sell, but with no accurate or even approximate knowledge of the possibilities for business in any town or in any commodity. The average salesman works with no record of what he has done in past years in that town, or of what commodities he has sold there, except as he may remember certain large or otherwise conspicuous orders secured from individual customers. Therefore he has no practical guide as to what he should sell there, or how much he should sell, save his judgment at the time and his interest at the time in his various commodities and customers. He has no bogey that will tell how much he should sell, or where, or what.

Rough Figures Set Up

We recently decided, therefore, to establish a quota system for our men the aim of which would be to set down the amount of business that they should be able to develop in each commodity they sell and ultimately to make that a quota for each community. We discussed this plan with our salesmen and they all asserted that it would be absolutely impracticable. All towns were different, they felt, and it would be impossible to forecast how much of any commodity could be sold. However, we went ahead and made an analysis of each man's sales for the last two years by commodities, and then we sat down with the salesman and studied these statements and tried to determine with him how much business we should be able to get in each town, dividing our totals according to the business which might be expected during the four quarters of the year. This of course was purely approximate and arbitrary and not scientific in any way for there is no reason for believing that the last two years' sales or any two years' sales can be taken as a basis for business possibilities. Yet we had to start somewhere.

Two Forms Used

So we went ahead and on the sheets reproduced here drew up a quota for each salesman under convenient groups of commodities, setting down the total sales expected for each in each quarter of the year. We began on the first of the year to keep a record each month of the sales

SALESMANS QUOTA AND ACTUAL SALES.

SALESMAN John Doe — MONTH OF February 1923.

Group Com.		QUOTA For 1st Quarter	QUOTA For February	MONTH Actual Sales	MONTH Over	MONTH Short	ACCUMULATED Over	ACCUMULATED Short	Necessary Sales in March to Meet Quota
10	Wiring Devices, including fuses	6000	2000	1440		560	460		1540
20	Rubber Covered Wire and Lamp Cord								
30	Weatherproof and Bare Copper Wire								
40	Rigid Conduit, Fittings, Conduiets, Outlet Boxes, Etc.								
50	Loom	300	100	25		75	75		25
60	Porcelain Knobs, Tubes and Cloats								
70	Meters								
80	Fans								
90	Pole Line Construction Material								
100	Dry Cell Batteries	999	333	330		3		18	351
110	Telephone Material								
120	Miscellaneous Supply Material								
130	Lamp Department								
140	Fixture Department, includes Street Lighting Equipment								
150	Batteries, Rectifiers and Auto Accessories								
160	Radio								
170	Washers, Ironers and Vacuum Cleaners								
180	Heating Devices and Other Socket Appliances								
190	Electric Ranges and Ovens								
200	Transformers								
210	Motors, Switchboards, Engines, Etc.								
220	Shop Labor and Material								
230	Outside Construction Labor								
	TOTAL								

SALESMAN.....

SALES YEAR 192.....

Group No.	MATERIAL	FIRST QUARTER Gross Sales	Credits	Net Sales	Quota	SECOND QUARTER Gross Sales	Credits	Net Sales	Quota	THIRD QUARTER Gross Sales	Credits	Net Sales	Quota	Gross Sales
10	Wiring Devices													
20	Rubber Covered Wire and Lamp Cord													
30	Weatherproof and Bare Copper Wire													
40	Conduit, Fittings, Outlet Boxes, Conduiets, Etc.													
50	Loom													
60	Porcelain Knobs, Tubes and Cloats													

FORMS ON WHICH QUOTAS AND SALES OF JOBBERS' SALESMEN ARE RECORDED AND COMPARED BY COMMODITIES AND TOWNS

to each community classified in this way. On each sheet the name of the town, the salesman and his code number are filled in. Within the city of St. Paul a sheet is carried for each important customer, and casual customers are grouped so that our city salesmen may work to a quota also. On the back of the sheet we keep a record of the number of calls made on each customer, taken from the daily reports.

Then at the end of each month we draw up the sheet, also shown here, giving a report on the salesman's quota and actual sales. This form is printed and filled out in "ditto ink," so that copies may be made on blank paper, and each salesman receives one each month for each town. He knows, therefore, as he approaches a town just how he stands—over or under his quota—and how his sales there have compared with sales in other towns. He can look for the reason why.

EFFECT ON SALESMEN

As a result of this we are now beginning to get actual figures on the sales of each salesman in each town by commodities, and a study of these figures is developing some interesting facts that are surprising to the salesman. For instance, in one town of 8,000 population one man during six months sold $350 worth of heating devices, but in another town of 24,000, only a short distance away, he sold only $200 worth. Before he saw the figure he was certain that he had got all the business that was possible out of the larger town, but when the actual sales were compared he could not reconcile the descrepancy. He knew that the bigger town should yield more business than the smaller.

In the beginning the men treated the whole thing as a joke—they laughed at it. But in the few months that the system has been in use they have discovered its worth to them and become enthusiastic. One of them recently said: "This is the first time that I have had a guide to what I am or am not doing and can see my weak spots." They are all watching the returns, studying and comparing them. They check up each case when some return of goods results in a smaller total sales than they expected. If they are disappointed in their sales in some town, they write and give us facts on the situation.

In short, the plan has given every man a new intensity of interest in his work and his responsibility for sales. We do not find fault when the total falls behind the quota. We do not use the quota to hound the men. The purpose is to give the men a means of checking up themselves—by towns and by commodities.

Next year, with a set of figures carrying twelve months' sales to every town and showing the totals on each commodity, we shall be in a position to make a real study and set a specific quota in advance for each town, for each salesman and for each commodity. We believe that this quota should not only recognize the total sales of 1921 and 1922 and the detailed reports on the sales of this year, but take into consideration also the population living in wired houses, the electrical conditions in the town—that is, the aggressiveness of the central-station company and dealers—the number of our customers, and also the strength of our salesman in the territory. From this we should be able to set a quota that will really reflect possibilities and not just our own selling history.

Already, however, the use of a practical quota on sales is proving of great value to our salesmen and therefore to the house, and we have no hesitation in recommending the plan to other jobbers and to manufacturers whose men must sell a varied line. Results are justifying the starting of the system on the most loosely approximate of figures, for even these are of real guiding value to the salesmen in their daily work.

Need the Dealer Lose His Line?

Facts from Hardware-Store Experience and Some Evidence from Electrical History—An Industry Problem that Needs Action

BY A. W. FISCHER
Director of Sales Magnetic Housecleaner Division,
Birtman Electric Company, Chicago

THEORETICALLY the dealer selects the kind of goods that he wants to sell out of his store, or the customers select the lines that the dealer carries by the expression of their preference in purchasing. In other words, the dealer sells what his customers want to buy. But as a matter of fact and experience it often happens that there is another thing that has a lot of influence in determining what a dealer sells. Other merchants take lines away from him by their superior skill in selling and sometimes force him practically to give up a profitable specialty or staple because the public is taught to buy these goods from some other kind of a store and they refuse to come to his store any more for them.

LOST LINES OF HARDWARE

Consider the hardware store, for example. The function of most hardware stores is merely to render a neighborhood service to the households of a community by providing a place where they may buy all kinds of metalware. When one wants nails or buckets or wire netting, or a stove or some tools to use in the home or garden, or a lawn mower or a poultry food hopper, the hardware store has them for sale. The carpenter also naturally goes there for his tools and nails and screws, and the plumber buys stuff there, and the farmer depends upon the hardware man for his spades and forks and in rural communities for plows and mowers and other agricultural machinery as well. And with this line of hardware are naturally grouped other associated materials, like window glass and weather strips and paint and brooms and cement and chickenfeed. All that and many other miscellaneous things make up the stock which we expect to find in a hardware store.

But wait a minute! Razors are hardware. They ought all to be sold out of the hardware store, yet they are not. We buy our safety razors from the drug store usually. Why? Because the man who sells soap decided one day that he could logically associate this article of specialty hardware with his staple and make some money at it, so he went after the safety-razor business and by better merchandising he has stolen the line away from the hardware man. Many men therefore go today to the druggist for their razors.

Cutlery is hardware also and used to be sold out of the hardware store. But today we buy much of it from the department store. And the department store has won away from the hardware dealer a great portion of the kitchen utensil business, just

as the department store has made itself headquarters for a lot of other popular merchandise that ten years ago used to be sold almost exclusively out of some other kind of a shop—and it is all right. Nothing can be said against the druggist for going out and rounding up the safety-razor business to sell with soap. We have no grievance, any of us, against the department-store man for selling our wives their baking dishes. The only criticism that can be expressed is against the hardware man himself for letting this easy-selling specialty of universal demand get away from him. For if he had been on his toes and made his store the chief source of information and supply on safety razors, we would all be purchasing our blades right there today.

LOST ELECTRICAL LINES

All of this, of course, is set down by way of background for the electrical dealer, for he is apparently allowing himself to follow the lead of the hardware man and lose some of the best lines of merchandise that his store can sell. The electrical dealer failed to do a job with dry batteries. In the beginning he sold them, but as the demand grew he failed to keep pace with his supply, and service and selling and other stores took them up until today the hardware man has won a tremendous volume of this business on which the electrical man might have been making the profit.

Likewise the hardware man is selling an enormous number of incandescent lamps that the dealer could be handling if he had sensed the change when the people began to become "lamp conscious" a few years ago and select for themselves, and had increased his advertising, his display and his lamp service. Moreover, the electric flashlight has become a steady seller in the hardware store. The hardware man took it up just as soon as the housewife grew convinced that this device was dependable, and it became a staple not just sold into the homes but bought by the people without asking the advice of some expert.

The hardware man also saw the change in the popular attitude toward the electric flatiron so he put it in his stock. He will be just as ready to stock all the other electric heating appliances and the motor-driven appliances if the way is left wide open for him to walk into the business. And the drug store will be selling most of the heat pads, vibrators, immersion heaters and devices of that kind, if we let him.

The question is, will the electrical dealer be willing to let the hardware man and the department-store man appropriate this exceedingly important function of merchandising in the electrical industry? And will the electrical manufacturer and jobber stand by and see it happen without taking some part in this affair which concerns them so vitally? The entire electrical industry should and naturally does want to see the electrical dealer prosper and grow in strength and influence. It is worth a great deal to it to have, as a skirmish line for distribution, a class of local retail dealers who are electrical men and both sympathetic with the ideals and purposes of the industry and intelligent in interpreting them.

If the electrical dealer can be as good a merchant as the hardware man, all electrical manufacturers and jobbers would rather have him sell their goods. But if the electrical dealer does not build himself up and make his store as appealing and helpful to the householder as the hardware store, when it comes to the sale of electrical appliances, then the hardware man and the drug-store man and the department-store man will go right on invading his market as certain lines one after another become staples. If this goes on, then the electrical dealer will have left only the specialties that are harder to sell and naturally bring him less prosperity during the period of building up than later when they are established in the market and in popular demand.

There is plenty of opportunity for the electrical dealer—a big job and a fine chance to prosper. But it is not just his problem. It is the problem as well of the man who makes and the man who distributes these goods that his store should sell, and they individually must undertake the responsibility for keeping their lines in the electric store by guiding, stimulating and assisting the electrical dealer to hold his lines. And the only way that any dealer can hold his line is by doing a better job of selling than some other merchant in some other store. It is time that we men behind the electrical dealer made ourselves responsible for seeing that he does this very thing. These facts are proof that we have not done enough so far.

Business Conditions

A Survey of Important Developments in the Electrical Market Including Data on Production, the Sales Outlook, Credits, Exports, the Metals and Other Conditions Affecting Cost, Supply and Demand

TRANSFORMER orders placed with American manufacturers since the first of the year have exceeded anticipations, and at present factory facilities are working very close to capacity. It is safe to say that in the last twelve years transformer sales in this country have been growing at the rate of 10 per cent compounded per annum, and there is much interest in manufacturing circles at this time to see whether this rate will be exceeded in the near future. All signs point to continued productive activity in this field for certainly the rest of this year.

Immersed Self-Cooled Types Are Taking the Field

IN TELLING of the activities in the transformer field, Westinghouse has received so far this year orders for large power transformers aggregating 750,000 kva. The business closed in January alone would have been a good six months' business a few years ago. A striking fact in connection with this great activity in transformers is the relatively large amount which are of the oil-immersed self-cooled type.

Shortage of Labor Affecting Transformer Production

BY LOOKING far ahead with respect to the supply of raw materials, leading transformer manufacturers have thus far been able to maintain full production. It is becoming increasingly difficult to obtain labor for the more skilled operations, and in some quarters toolmakers are particularly hard to obtain. Distribution transformers are still obtainable in reasonable quantities from factory stocks. Power transformers, however, are being quoted on long deliveries, sometimes running into eight or nine months and rarely falling below seven months on comprehensive orders. There has been little recent change in prices, but the rising costs of steel, insulation and labor, combined with the burdens of taxation and other overhead expenses, make it not improbable that some further adjustment may take place. In typical cases distribution transformers are selling at about one-third above pre-war figures, power transformers running below the distribution type in percentage advance. In

discussing the situation the point is effectively made that only a moderate advance was registered during the war in comparison with many other lines of electrical apparatus, and attention is drawn to the low ratio of transformer cost to the total cost of modern hydro-electric transmission development, frequently of the order of 1.5 to 3 per cent.

Ameliorating Depression Evils When Business Is Booming

CONCLUSIONS by the committee appointed by Secretary of Commerce Hoover as chairman of the President's conference on unemployment have been made public after more than a year's study. Recommendations are under ten headings:

Collection of fundamental data.
Larger statistical service.
Research.
Control of credit expansion by banks.
Possible control of inflation by the Federal Reserve System.
Control by business men of the expansion of their own industries.
Control of private and public construction at the peak.
Public utilities.
Unemployment reserve funds.
Employment bureaus.

Most of the report is devoted to the importance of the collection of fundamental data. It says: "What is evidently needed is an increase in the resources of the Department of Commerce and a larger degree of cooperation with the department in co-ordinating and extending business information, so that business men and bankers may know promptly the facts about the rate of production measured in physical units, the stock on hand and in transit, the trend of prices, the volume of sales and the trend in money rates."

Of equal importance to the electrical industry is the sixth recommendation, which emphasizes the point that "Planning production in advance and with reference to the business cycle, laying out extensions of plant and equipment ahead of immediate requirements with the object of carrying them out in periods of depression and carrying through such construction plans during periods of low prices in conformity with the long-time trend, the accumulation of financial reserves in prosperity in order to mark down inventories at the peak, and the maintenance of a long view of business problems rather than a short view, will enable firms to make headway toward stabilization."

Highly Competitive Tape Market Has Many Turnovers

VIGOROUS activity accompanied by acute competition for business is the feature of the friction-tape market, which is responding to the stimulus of increased wiring construction throughout the country. The use of black tape has become practically universal, probably not more than 1 per cent of sales being white specifications. Many hundreds of thousands of pounds of friction tape are being produced monthly in the United States, and jobbers are making a fairly rapid turnover of this product as it reaches their shelves. Foreign demand is reported to be improving in quarters where this class of trade is assiduously cultivated. Raw materials are in good supply, but their costs have stiffened sharply within the past year. Cotton at double last year's price now costs the tape manufacturer in the vicinity of 30 cents per pound (sheeting quotes 15 cents per yard and about one yard is required per pound of tape), and rubber sells around 35 cents per pound against 18 to 20 cents a year ago. Labor is not so difficult to secure, at least in representative plants where working conditions are thoroughly satisfactory, but the wage level is maintained at a high index figure. Automatic machinery is being utilized more and more in tape manufacture.

Inexperienced Producers and Rising Costs Causing Unsteady Prices

SOME unsteadiness of prices in the tape market exists. This condition is due in part to the entrance of relatively inexperienced producers into the field, coupled with the rising cost of materials. In few lines of electrical manufacture has there been less appreciation of the meaning of quality products than in tape. In the past too much buying has been conducted on the theory that "tape is tape," and the difference between initial appearance and lasting quality has been overlooked by many purchasers. Hasty purchases based on the lowest obtainable quotation have been made without suitable study of the material offered and its record of durability in service.

Steady Demand for Washers and Cleaners

WASHERS and cleaners appear to be doing a staple business, although the usual spring acceleration of demand is due. Competition is so widespread in this field and factories are so scattered that little complaint is being heard as to inability to supply local trade. Where particular makes are insisted upon at points far from the jobber's stock or producing plant, delay in filling orders is, of course, necessary in some cases; but, by and large, requirements have been well anticipated. New developments continue to interest the trade in the line of improved designs of apparatus, and the bearing of servicing is being considered more and more by dealers as a factor in securing satisfied customers. Reports have been received of some house-to-house motor-truck sales at cut prices, but these appear to be devoid of service features which are demanded and appreciated by intelligent buyers. On the whole, trade is in a healthy condition unless one deprecates the widespread manufacturing competition which characterizes current business in these outfits.

Iron Manufacturers Keeping Well in Line on Raw Material Side

A STEADY and sustained demand for electric flatirons characterizes the current market, with little spectacular news. The manufacturers are very busy and by careful attention to buying for a well-studied demand are keeping well in line on the raw-material side. Prices remain firm; deliveries are on the whole in good shape, and the growth of new and old house wiring in many localities is stimulating sales. Normal replacement business and some duplication orders for reserve in the household equipment are adding to the total.

Storage Battery Buying Quickened During Last Few Weeks

SUSTAINED interest in radio and increasing requests for proposals in connection with industrial and road truck service have quickened the buying of storage batteries during the past few weeks. Local stocks are being maintained only with difficulty, but manufacturing facilities were so increased during the past year or two that the situation has not given much trouble. Prices stiffened slightly on some types early this month. The expansion of central-station plants is resulting in some control-battery sales, and there is an active trade in starting and lighting batteries for motor-vehicle use as the season "goes into high" in automobile purchasing.

Depending on the Government's Foreign Trade Pointers

INCREASING use of help and advice by the government's bureaus is seen in the recent report by the directors of the Bureau of Foreign and Domestic Commerce which stated that 135,000 personal calls were made in the interest of manufacturers during the year 1922. This is nearly double the number in any previous year. The Department of Commerce is encouraging co-operation with about seventy trade associations in the promotion of foreign trade through committees representing in all a membership of 150,000. The prospective users of the foreign bureau's service may have their names and interest in export trade recorded in the department's "Exporters' Index." At present this comprises fifteen thousand American merchants and manufacturers entitled to information on foreign trade opportunities and receiving confidential news bulletins.

Study of Trade Necessary in Australia's Electrical Market

ASKED how the American manufacturer can increase his trade with Australia in electrical supplies and equipment, W. G. Watson, chairman and managing director of W. G. Watson & Company, Ltd., electrical engineers of Sydney, who is in San Francisco on business, stated to a correspondent of the ELECTRICAL WORLD:

"If you reduce your prices, you can

sell more goods. The present upward trend of prices of electrical goods in America is going to make it still more difficult to sell goods in Australia. If American manufacturers, exporters and shippers studied more fully the Australian requirements, it would be of considerable assistance to them.

"Appliance sales in Australia move about in the same proportion to population as in the United States. The electric ranges manufactured in the United States are too costly to allow for any large sales due to the high cost of getting the goods into the Australian markets. There exists an acute shortage of power, and plants almost everywhere are being increased in capacity. The completion of the Morwell scheme in Victoria will supply current at a pressure of 150,000 volts to Melbourne and other large cities. Steel core aluminum conductors and suspension insulators are being used."

Germans Report Their Large Equipment Market Suffering

THE report of the Prussian Chambers of Commerce on German trade and industry during February states that in the electrical industry the inland purchasing power is weak. Neither official nor private customers dare place orders for large plant and machinery. Further, the partial fall of prices is causing some customers to hold back in the hope of further reductions. Foreign countries, for the most part, are showing reserve, in so far as the German prices, which have partly reached the world's market level and partly already exceeded it, admit of any competition. Accordingly a general falling off in orders is noticeable in high-pressure current articles, machinery, apparatus, installation materials and cables. The outlook for railway safety appliances is poor, and the sale of electric lamps in Germany and abroad shows no improvement.

Germany's Electrical Exports via New York Double England's

SPECIAL preliminary figures showing imports of electrical goods through the port of New York during March showed that Germany sent $32,905 and England $17,123 worth. France sent $14,643 and all other countries $6,659. The highest value of an imported commodity from Germany was for sockets to the amount of $7,731. No sockets were imported from England. Electric iron imports from Germany were valued at $512. Other figures are as follows:

	Germany	England
Batteries	$512	...
Lighting fixtures	4,170	$675
Heaters	804	108
Plugs	122	146
Sockets	7,731	...
Flashlights	1,666	...
Vacuum cleaners	30	...
Wireless apparatus	963	370
Bells	2,533	...
Hair driers	3,981	...
Carbons	6,917	5,824
Telegraph and cable apparatus	...	10,000

The Metal Market

Most producers continue to quote copper at 17.37½ cents delivered, but report only occasional orders for small tonnages at that level. Copper is obtainable at 17.25 cents in two or three directions, but at that price also the volume of business has been small. Some forward copper has been sold at a considerable discount from this price, and consumers near New York where the freight rate is low have also been able to do better than 17.25 cents delivered. There is as yet no evidence of a buying movement, but it is thought that this cannot be postponed much longer, and few breaks in the ranks of producers holding for 17.37½ cents are expected. The export demand has also been weak.

The railway and electric subsidiary companies of the Public Service Corporation of New Jersey have placed orders for 4,000,000 lb. of copper to meet their operating necessities for the current year. All but a small part will be in the form of wire and cables. It is estimated that the electric company will consume about three-fourths of the total order to supply requirements for extensions.

NEW YORK METAL MARKET PRICES

Copper	April 4, 1923 Cents per Pound	April 11, 1923 Cents per Pound
Electrolytic	17.37½	17.37½
Lead, Am. S. & R. price	8.25	8.25
Antimony	8.75	8.75
Nickel, ingot	30.00	30.00
Zinc, spot	7.65	7.55
Tin, Straits	48.00	48.00
Aluminum, 98 to 99 per cent	26.00	24.00

The Week in Trade

Prices When Quoted Are Those Reported at the Opening of Business on Monday of This Week for Points West of the Mississippi River and on Tuesday for All Eastern Points

INCREASED building construction and spring replacements are having a favorable effect on the industry in all parts of the United States. Motors and controlling devices are going to the industries in greater volume. Insulator manufacturers report unusually good business, some saying that the last month has been far above any month in three years. Shipments no longer hold stocks of commodities, but shortages are mostly due to lack of raw materials in the factories. Prices are stiffening in lamp cord, switches, tape, galvanized conduit and weatherproof wire.

Boston Business continues very active, with prices stiffening in lampcord, switch boxes, tape, galvanized conduit and weatherproof wire. Few shortages are reported by jobbers except in radio tubes. Road conditions still hamper the movement of heavy supplies by truck in the interior. Money is easy and no marked evidence of inflation was in sight Monday. Building operations gained 8 per cent over the first quarter of 1922 in the corresponding period this year, but a reaction in building is expected as a result of price changes in materials and labor shortage. Central-station expansion continues steady, and the construction of important interconnections is a factor in business.

New York Purchases in the retail trade are somewhat better, while buying from the jobbers is only fair. Manufacturers are buying raw materials in larger quantities and making many plant changes in view of increased production. Lamp sales during the week were in greater volume. Wire and wiring-device stocks are said to be lower owing to a heavy drain to new buildings. All supplies entering into central-station expansions are moving faster.

Baltimore Conditions are unusually bright, and prospects are for heavy business in every line with the opening of the spring season. There is a special drive on at the present time for the sale of cleaners and washers with a steady demand for this commodity. Storage batteries are very active with the supply normal. Radio equipment has fallen off to a certain extent owing to seasonal conditions. Wire is still very active.

Atlanta The general situation shows a continued gain in strength in practically every line, with a tendency toward price increases in the majority of electrical products. This is particularly true of all materials into which steel largely enters, and there are some expressions of opinion that slight increases will be noted in appliance lines before fall. One jobber reports that he has more unfilled orders on his books than at any time since 1920.

Cleveland Stability is reflected in the week's orders. Manufacturers have advanced prices slightly on copper products, but stocks are in good shape. New construction is keeping meters and fixtures in active demand.

Chicago Business continues very active, with jobbers and dealers reporting good demand for most commodities. Several advances were announced this week. Wire advanced approximately 5 per cent, porcelain 5 per cent and 10 per cent on certain types of insulators, wiring devices 10 per cent and transformers 5 per cent. Conduit prices remain the same, with an anticipated increase in prices of lock nuts and bushings.

Demand, Supply and Price Trend of Nineteen Commodities as Sold in Sixteen Cities

Explanation:
Demand: Steady, Slow or Active
Supply: Normal, Low or High
Price Trend: Firm, Decreasing or Increasing

Next Week Reports will include Conduit Boxes; Dry Batteries and Tape

	Wire	Armored Cable	Conduit	Transformers	Poles	Pole Line Hardware	Porcelain	High-Tension Equipment	Fuses	Meters	Switches	Wiring Devices	Lamps	Commercial Fixtures	Motors	Radio	Washers and Cleaners	Irons	Storage Batteries
Boston																			
Demand	Act.	Act.	Act.	Act.	Act.	Act.	Act.	Act.	Act.	Act.	Act.	Act.	Act.	Act.	Act.	Act.	Sdy.	Sdy.	Act.
Supply	Nml.	Nml.	Nml.	Nml.	Low	Low	Low	Low	Nml.	Nml.	Nml.	Nml.	Nml.	Nml.	Low	Low	Nml.	Nml	Low
Price trend	Inc.	Firm	Firm	Inc.	Firm	Firm	Firm	Firm	Firm	Firm	Firm	Firm	Firm	Firm	Firm	Dec.	Firm	Firm	Inc.
New York																			
Demand	Act.	Act.	Sdy.	Act.	Act.	Act.	Act.	Act.	Act.	Act.	Act.	Act.	Act	Sdy.	Act.	Act.	Sdy.	Act.	Act.
Supply	Nml.	Nml.	Nml.	Nml.	Low	Nml	Low	Nml.	Nml.	Nml.	Nml.	Nml.	Nml.	Nml.	Low	Low	Nml	Nml	Nml
Price trend	Inc.	Firm	Firm	Inc.	Firm	Inc.	Firm	Firm	Inc.	Firm	Firm	Firm	Firm	Firm	Firm	Dec.	Firm	Firm	Inc.
Baltimore																			
Demand	Act.	Slow	Act.	Sdy.	Slow	Slow	Sdy.	Slow	Act.	Slow	Act.	Act.	Act.	Sdy.	Act.	Sdy.	Sdy.	Sdy.	Act.
Supply	Nml.	Nml.	Nml.	Nml.	Nml.	Nml.	Nml.	Nml.	Nml.	Nml.	Nml.	Nml.	Low	Nml.	Nml.	Nml.	Nml.	Nml.	Nml.
Price trend	Inc.	Inc.	Inc.	Firm	Firm	Firm	Firm	Firm	Firm	Firm	Firm	Firm	Firm	Firm	Firm	Firm	Firm	Firm	Firm
Atlanta																			
Demand	Act.	Act.	Act.	Sdy.	Act.	Act.	Act.	Slow	Act.	Act.	Act.	Act.	Act.	Act.	Sdy.	Sdy.	Slow	Act.	Act.
Supply	Low	Nml.	Low	Nml.	Low	Nml.	Nml.	Low	Nml.	Nml.	Nml.	Nml.	Nml.	Low	Nml.	Nml.	Nml.	Nml.	Nml.
Price trend	Inc.	Inc.	Inc.	Firm	Inc.	Firm	Firm	Firm	Firm	Firm	Firm	Inc.	Firm	Firm	Firm	Firm	Firm	Firm	Firm
Pittsburgh																			
Demand	Act.	Sdy.	Act.	Sdy.	Sdy.	Act.	Sdy.	Sdy.	Sdy.	Sdy.	Sdy.	Sdy.	Sdy.	Sdy.	Sdy.	Sdy.	Act.	Sdy.	Sdy.
Supply	Nml.	Nml.	Nml.	Nml.	Nml.	Low	Nml.	Nml.	Nml.	Nml.	Nml.	Nml.	Nml.	Nml.	Nml.	Nml.	Nml.	Nml.	Nml.
Price trend	Inc.	Firm	Firm	Firm	Firm	Inc.	Firm	Firm	Firm	Firm	Firm	Firm	Firm	Firm	Firm	Firm	Firm	Firm	Firm
Cleveland																			
Demand	Act.	Act.	Act.	Act.	Act.	Act.	Sdy.	Act.	Sdy.	Act.	Act.	Act.	Act.	Act.	Act.	Act.	Act.	Sdy.	Sdy.
Supply	Nml.	Low	Low	Nml.	Nml.	Nml.	Nml.	Nml.	Nml.	Nml.	Nml.	Nml.	Nml.	Nml.	Nml.	Nml.	Nml.	Nml.	Nml.
Price trend	Inc.	Inc.	Inc.	Firm	Firm	Firm	Firm	Firm	Firm	Firm	Firm.	Firm	Firm	Firm	Firm	Firm	Firm	Firm	Firm
Chicago																			
Demand	Act.	Sdy.	Act.	Act.	Act.	Act	Sdy.	Act.	Sdy.	Act.	Act	Act.	Act.	Act.	Act.	Act.	Act.	Act.	Act.
Supply	Nml.	Nml.	Low	Nml.	Nml.	Low	Low	Nml.	Nml.	Nml.	Nml.	Nml.	Nml.	Nml.	Nml.	Nml.	Nml.	Nml.	Nml.
Price trend	Inc.	Inc.	Inc.	Inc.	Firm	Firm	Firm	Inc.	Inc.	Firm	Firm	Firm	Firm	Firm	Firm	Firm	Firm	Firm	Firm
St. Paul-Minneap.																			
Demand	Act.	Slow	Act.	Sdy.	Act.	Act.	Sdy.	Act.	Sdy.	Sdy.	Sdy.	Act.	Act.	Act.	Slow	Sdy.	Sdy.	Sdy.	Slow
Supply	Nml.	Nml.	Low	Nml.	Nml.	Nml.	Nml.	Nml.	Nml.	Nml.	Nml.	Nml.	Nml.	Nml.	Nml.	Nml.	Nml.	Nml.	Nml.
Price trend	Firm	Firm	Inc.	Firm	Firm	Inc.	Firm	Firm	Firm	Firm	Firm	Inc.	Firm	Firm	Firm	Dec.	Firm	Firm	Firm
St. Louis																			
Demand	Act.	Sdy.	Act.	Act.	Sdy.	Sdy.	Sdy.	Act.	Sdy.	Slow	Sdy.	Sdy.	Sdy.	Act.	Act.	Act.	Sdy.	Sdy.	Act
Supply	Low	Nml.	Low	Low	Nml.	Nml.	Nml.	Nml.	Nml.	Nml.	Nml.	Nml.	Nml.	Nml.	Low	Nml.	Nml.	Nml.	Nml.
Price trend	Firm	Firm	Firm	Inc.	Firm	Firm	Firm	Firm	Firm	Firm	Firm	Firm	Firm	Firm	Firm	Firm	Firm	Firm	Firm
New Orleans																			
Demand	Act.	Act.	Act.	Sdy.	Sdy.	Act.	Sdy.	Sdy.	Sdy.	Sdy.	Sdy.	Act.	Act.	Act.	Sdy.	Sdy.	Slow	Sdy.	Sdy.
Supply	Low	Nml.	Low	Nml.	Low	Low	Nml.	Low	Nml.	Nml.	Nml.	Low	Nml.	Nml.	Nml.	Nml.	Nml.	Nml.	Nml.
Price trend	Inc.	Firm	Inc.	Firm	Inc.	Inc.	Firm	Firm	Firm	Firm	Firm	Inc.	Firm	Firm	Firm	Firm	Firm	Firm	Firm
Denver																			
Demand	Act.	Sdy.	Act.	Slow	Sdy.	Sdy.	Sdy.	Slow	Act.	Slow	Sdy.	Act.	Act.	Act.	Slow	Act.	Slow	Sdy.	Nml.
Supply	Nml.	Nml.	Low	Low	Nml.	Nml.	Nml.	Low	Nml.	Nml.	Nml.	Nml.	Nml.	Nml.	Nml.	Nml.	Nml.	Nml.	Firm
Price trend	Inc.	Inc.	Inc.	Firm	Firm	Inc.	Firm	Firm	Firm	Firm	Firm	Inc.	Firm	Firm	Firm	Firm	Firm	Firm	Sdy.
Salt Lake City																			
Demand	Act.	Sdy.	Act.	Sdy.	Sdy.	Slow	Act.	Sdy.	Slow	Sdy.	Sdy.	Sdy.	Act.	Act.	Slow	Act.	Sdy.	Sdy.	Sdy.
Supply	Low	Nml.	Low	Nml.	Nml.	Nml.	Nml.	Nml.	Hi.	Nml.	Nml.	Nml.	High	Nml.	Nml.	Nml.	Nml.	Nml.	Nml.
Price trend	Inc.	Firm	Inc.	Firm	Inc.	Inc.	Inc.	Firm	Firm	Firm	Firm	Inc.	Firm	Inc.	Firm	Firm	Firm	Firm	Firm
Portland-Seattle																			
Demand	Act.	Act.	Act.	Act.	Act.	Act.	Slow	Sdy.	Sdy.	Act.	Sdy.	Sdy.	Act.	Sdy.	Sdy.	Act.	Sdy.	Sdy.	Act.
Supply	Nml.	Nml.	Low	Nml.	Nml.	Nml.	Nml.	Low	Nml.	Nml.	Nml.	Nml.	Nml.	Nml.	Nml.	Nml.	Nml.	Nml.	Nml.
Price trend	Inc.	Inc.	Inc.	Firm	Inc.	Firm	Firm	Firm	Firm	Firm	Inc.	Inc	Firm	Firm	Firm	Firm	Firm	Firm	Firm
San Francisco																			
Demand	Act.	Act.	Act.	Sdy.	Sdy.	Act.	Sdy.	Sdy.	Sdy.	Sdy.	Sdy.	Act.	Act.	Act.	Act.	Act.	Sdy.	Act.	Act.
Supply	Nml.	Nml.	Low	Nml.	Nml.	Nml.	Nml.	Nml.	Nml.	Nml.	Nml.	Nml.	Nml.	Nml.	Nml.	Nml.	Nml.	Nml.	Nml.
Price trend	Inc.	Inc.	Firm	Firm	Firm	Firm	Firm	Firm	Inc.	Firm	Inc.	Inc.	Firm	Dec.	Firm	Firm	Firm	Firm	Firm

St. Louis Sales of electrical supplies for the past month were approximately 20 per cent greater than for the same period in 1922. There is a splendid demand for radio sets, installation material for new buildings, automotive equipment and household appliances. The trend of prices is upward, especially on anything containing copper and steel. Some improvement is reported in the demand for pole hardware and all other materials used by public utilities.

St. Paul-Minneapolis Washers and cleaners are moving fairly well, but winter weather is holding this business as well as all others back. Prices seem more steady with a slight incline all along the line. The conduit situation is better. Radio is slowing up.

San Francisco Dealers' business is good with better sales on larger household appliances. Conduit boxes are in active demand with stocks low and prices firm. Tape stocks are normal. Recent packing changes have considerably stimulated quantity buying.

Denver Increasing prosperity in this region indicates a healthy demand for appliances of all types. Radio is holding up well, and as a consequence batteries and rectifiers when obtainable are moving also. Shortage in materials now appears to be due to manufacturers' inability to supply demand rather than to delayed transportation facilities. Uncertain prices are preventing placement of surplus stock orders. Collections have not shown the desired improvement.

Portland-Seattle Price levels remained about the same for the past week, but all building materials show a strong upward tendency due to very heavy demand. Wage scales have advanced in some of the building trades crafts. The increasing trend in prices of both material and labor is having a deterrent effect upon new building projects in some sections. Electrical jobbers report active industrial and central station demands, with a decrease in country business. Conduit stocks have materially improved in the past few weeks.

Activities of the Trade

Devoted to News of the
Manufacturer, Jobber, Agent, Contractor and Dealer, Including Important Orders and Contracts for Apparatus and Equipment

Pelton Water Wheel Awarded Large Pacific Coast Order

The Pelton Water Wheel Company, San Francisco, has been awarded a contract by the Portland Railway, Light & Power Company for furnishing a 72-in. butterfly valve for the lower end of the penstock and a 72-in. Johnson valve for the upper end of the penstock on its Oak Grove project. The turbine for this job which is now under construction at the Pelton shops is a vertical unit and will develop 35,000 hp. under a head of 850 ft. It will be the highest-head reaction turbine in the world.

Approves Fixture Appeal

Assistant Secretary of the Treasury Moss approved last week the action of the Assistant Attorney-General at New York in appealing to the Court of Customs Appeals from the decision of the Board of General Appraisers in connection with the proper duty on electric light fixtures.

The appraisers' decision held that certain electric light fixtures classified as metal articles plated with gold or silver dutiable at 50 per cent ad valorem under paragraph 167 of the tariff act of 1913 were properly dutiable at the rate of 20 per cent ad valorem under the same paragraph of that act.

Black & Decker Resume Payments on Common Stock

The Black & Decker Manufacturing Company, Towson, Md., manufacturer of portable electric tools, announces that the regular quarterly dividend has been declared on preferred stock, and that the payment of dividends on common stock has been resumed, these having been discontinued for about a year, following the recent depression.

Wagner Electric 1922 Earnings Were $265,934

The annual report of the Wagner Electric Corporation for 1922 to its stockholders shows net operating earnings of $265,934 for the year 1922, after deducting physical depreciation and interest charges. After the payment of preferred-stock dividends of $52,500, earnings applicable to the common stock were $213,484, or at the rate of $2.73 per share on the outstanding common stock of the corporation.

All bank obligations were paid Aug. 11, 1922, and no bank borrowings were necessary to operations during the rest of 1922. The current liabilities shown reflect in general the normal obligations of the corporation incident to current business. Inventories of raw materials, work in process and finished products are priced at cost or the current market, whichever was lower. A very substantial improvement of the general business of the company was reflected in the last quarter of the year, and incoming sales for the first quarter of 1923 show a substantial increase over the same period in 1922.

Combustion Engineering Handle Uehling Instruments in Canada

The Combustion Engineering Corporation, Ltd., and the Uehling Instrument Company have recently entered into an agreement whereby Uehling interests in the Dominion of Canada and Newfoundland will be handled exclusively by the Combustion Engineering Corporation, Ltd., with principal offices in Toronto, Montreal, Winnipeg and Vancouver.

Inspiration Copper Sales Totaled $10,236,894

The Inspiration Consolidated Copper Company, in its annual report issued to stockholders last week, showed that its sales of copper in 1922 totaled $10,236,894, compared with $8,636,498 the preceding year. After expenses, depreciation and interest, there was an operating profit of $255,246, but an expenditure of $229,081 on account of suspension of operations left a net income of only $26,165, against a deficit in 1921 of $1,790,421.

Current assets at the end of the year, according to the Dec. 31 balance sheet, were $6,688,837, contrasted with current liabilities of $1,165,180. Of the current assets $2,518,745 consisted of cash and cash assets.

De Forest Radio Sold

A controlling interest in the De Forest Radio Telephone & Telegraph Company, Franklin Street, Jersey City, N. J., has been secured by Edward T. Jewett, head of the Paige-Detroit Motor Car Company, Fort Street, Detroit, and associated local interests. Plans are under way for enlargements in the Jersey City works to double approximately the present capacity. Dr. Lee de Forest will act as consulting engineer for the new organization in the development of radio equipment.

Ideal Electric Office Change

The Ideal Electric & Manufacturing Company, Mansfield, Ohio, has announced the consolidation of its Chicago office, formerly at 701 Fisher Building, with the Gebhardt Company & Associates, at 1419 Fisher Building, Chicago.

Dwight P. Robinson Opens Philadelphia Office

The opening of a Philadelphia office is announced by Dwight P. Robinson & Company, engineers and constructors, New York City. The new office will be under the direction of Carl A. Baer, recently with the firm of Baer, Cook & Company, engineers, and a consulting engineer in the design of industrial, textile and power plants.

Westinghouse Gets Philadelphia Order for 20,000 Meters

The Philadelphia Electric Company, which supplies the city of Philadelphia with electric light and power, has ordered from the Westinghouse Electric & Manufacturing Company 20,000 type OA watt-hour meters of various sizes. The value of the order was approximately $160,000.

The order, which is intended to satisfy the requirements of the Philadelphia company for several months, is one of the largest ever placed for such meters and is an indication of the very great increase in the demand for domestic lighting circuits. Although the size of the order is only in line with the general rapid improvement in the electrical industry throughout the country and is simply another evidence of the improvement in business conditions, specifically it is an indication of the large increase in home building activities in Philadelphia and other cities.

The Ohio Brass Company, Mansfield, Ohio, manufacturer of brass goods for electrical service, is planning for extensions at its local plant as well as at its branch works at Toronto, Ont. It is also purposed to make enlargements at the plant of the Ohio Insulator Company, Barberton, Ohio, a subsidiary organization, to increase the capacity approximately 50 per cent. Additional equipment will be installed at the latter works.

The O. K. Battery Company, Dallas, Tex., has acquired property at 934-36 North Lancaster Avenue for a new plant for the manufacture of electric storage batteries and kindred electrical products. The structure is two-story and will be equipped for an output of about five hundred batteries daily.

The Betts & Betts Corporation, 645 West Forty-third Street, New York City, has made arrangements with Marshall & Company, Union League Building, Los Angeles, to handle its line of radio apparatus in the Pacific Coast territory.

The Condensite Company of America, Bloomfield, N. J., a division of the Bakelite Corporation, manufacturer of insulation products, will soon commence the construction of a new addition to its plant on Grove Street, to cost $32,000.

The Bryant Electric Company, Hancock Avenue, Bridgeport, Conn., will soon build a new addition 32 ft. x 56 ft., contract for which has been awarded.

Foreign Trade Opportunities

Following are listed opportunities to enter foreign markets. Where the item is numbered further information can be obtained from the Bureau of Foreign and Domestic Commerce, Washington, by mentioning the number.

Purchase is desired in England (No. 5,960) for the best quality of copper rods for the manufacture of electric cables in quantity of about 60 tons per month.

An agency is desired in Denmark (No. 5,999) for machine tools, small tools, electrical material, etc.

The following inquiries have been received by the Philadelphia Commercial Museum, which will furnish names and addresses of the inquirers to any one desiring them and mentioning the number given: Parties in Bombay, India (No. 40,507), desire agencies for electrical goods, engineering supplies, etc. Addresses of concerns selling wireless telephone apparatus are desired by a party in Vera Cruz, Mexico (No. 40,568). A party in Stockholm, Sweden (No. 40,572), would like to communicate with manufacturers of forced-draft furnaces to be used with electric motor and blower.

THE AMERICAN MANUFACTURERS' FOREIGN CREDIT UNDERWRITERS, Inc., 110 William Street, New York City, have received an inquiry from a company at Tabasco, Mexico, which would like to get in touch with American manufacturers of batteries, flashlights and kindred electrical products.

INCREASING DEMAND FOR ELECTRICAL APPARATUS IN MEXICO.—Improvements to the electric service in the cities of Aguascalientes and Zacatecas, Mexico, and the extension of the electric lighting system to nearby towns, *Commerce Reports* states, has created an increasing demand for the cheaper electric household devices, such as electric flatirons, hot plates, toasters, etc.

LEONARD WORK, MANUFACTURERS' REPRESENTATIVE, 40 Rue Laffitte, Paris, France, desires to communicate with manufacturers of insulated wire and would like to receive prices and samples of the following; Annunciator wire, assorted colors; annunciator wire, twisted pairs, assorted colors; telephone twisted pair, inside wire; radio antenna wire, enameled wire for radio reactance coils, braided wire, rubber-covered sizes 16 to 12 (for lighting), braided rubber-covered fixture wire, and thin sheet copper such as is used for condensers in radio telephony.

PUBLIC UTILITIES OF VICTORIA, BRAZIL, LEASED TO AN AMERICAN-CONTROLLED COMPANY. — The public utilities of Victoria, Espirito Santo, Brazil, according to *Commerce Reports*, have been leased to the Servicos Reunidos de Victoria, S. A., which is controlled by George A. Hodge, who is an American. The lease covers the operation of a hydro-electric station, furnishing electricity for lighting and power, operation of tramways, telephone system, water supply and sewage system.

New Apparatus and Publications

MOTOR STARTERS AND INDUSTRIAL SWITCHES. — The Square D Company, Detroit, has issued bulletins No. 20, No. 21 and No. 30, entitled "Motor Control Switches," "Wiring Data for Motors" and "Industrial Switches with Positive Quick Make and Quick Break and Cover Control Fused and Unfused" respectively.

PORCELAIN COVER FOR LINE TERMINALS.—A new porcelain cover for line terminals has been developed by the Square D Company, Detroit.

PUMP VALVE. — A new pump valve known as the "Seal" has been brought out by the Worthington Company, Inc., 115 Broadway, New York City.

PUMPING EQUIPMENT.—A leaflet distributed by the De Laval Steam Turbine Company, Trenton, N. J., describes and illustrates the "De Laval" pumping equipment in the new Baltimore refinery of the American Sugar Refining Company.

PANELBOARD.—The Benjamin Electric Manufacturing Company, 847 West Jackson Boulevard, Chicago, is distributing a circular covering its dead-front panelboard.

BENCH DRILL.—The Wisconsin Electric Company, Racine, Wis., has placed on the market a new sensitive drill known as the "Dumore" type "A" drill.

ELECTRIC INCUBATOR. — The Petaluma (Cal.) Electric Incubator Company has brought out an improved model of its electric incubator.

IRONING MACHINE. — The Modern Home Appliance Company, Kansas City, Mo., has added an electric ironing machine to its "Sieben" line of electrical laundry equipment.

WINDOW-DISPLAY DEVICE.—An animated window-display device, "Sellsem," has been brought out by the Animated Advertising Service, 130 West Forty-second Street, New York City.

BELL-RINGING TRANSFORMER. — A bell-ringing transformer "No. 77," designed for doorbells, buzzers, etc., has been developed by the Jefferson Electric Manufacturing Company, 426 South Green Street, Chicago.

OUTLET BOX.—A new collar-clamp outlet box, "Merrico," has been brought out by the Merrill Company, Ipswich, Mass.

New Incorporations

THE GREEN & TAYLOR ELECTRIC COMPANY, Hazard, Ky., has been chartered with a capital stock of $10,000 by J. G. Green, H. T. and A. T. Taylor.

THE FARMINGTON (N. C.) ELECTRIC LIGHT COMPANY has been incorporated with a capital stock of $15,000 by E. C. James, W. E. Kennen and C. A. Hartman.

THE WELCOME (N. C.) LIGHT & POWER COMPANY has been incorporated with a capital stock of $50,000 by J. A. Johnson, Winston-Salem; W. O. Burgin, Lexington, and L. C. Ripple, Welcome.

THE LEAGUE CITY (TEX.) LIGHT & POWER COMPANY has been organized by W. M. Truxaw, E. T. Arnett and C. Trifon.

THE EVANS LIGHT & POWER COMPANY, Woodville, Tex., has been incorporated with a capital stock of $12,000 by T. E. and J. H. Evans and J. P. Lindsey.

Construction News

Projects, Plans, Bids and Contracts, Contemplated or Under Way

New England States

BOSTON, MASS.—The Edison Electric Illuminating Company will build an addition to its substation at East Boston, to cost $65,000.

BROCKTON, MASS.—The Edison Electric Illuminating Company contemplates extensions to its system.

EAST WALPOLE, MASS. — Electric power equipment will be installed in the proposed additions to the plant of Bird & Sons, Inc., to cost about $300,000. Monks & Johnson, 89 Chauncey Street, Boston, are architects.

WORCESTER, MASS.—The New England Power Company has been granted authority to issue $3,000,000 in capital stock, the proceeds to be used for a hydro-electric plant at Whitingham, Vt., erection of transmission lines, new substation at Lanesboro, etc.

HARTFORD, CONN.—The directors of the Connecticut Power Company have authorized an issue of $750,000 in capital stock to finance the erection of a 110,000-volt transmission line from the Agawam (Mass.) substation of the Turners Falls Power Company to the South Meadow plant of the Connecticut Power Company and a line from Hartford to New Britain.

NEW LONDON, CONN.—The Eastern Connecticut Power Company, it is reported, contemplates building an addition to its power plant at Uncasville, to cost about $400,000.

Middle Atlantic States

CARMEL, N. Y.—The Carmel Light & Power Company contemplates extensions to its distributing lines. S. C. Dunning is treasurer and general manager.

COHOES, N. Y.—The installation of a 10,000-hp. generating unit is under consideration by the Cohoes Power & Light Corporation.

JAMESTOWN, N. Y.—The installation of two 500-hp. water-tube boilers with stokers and accessories in the municipal electric light plant and the erection of a 200-ft. radial brick chimney are under consideration by the Department of Water and Lighting. Melvin O. Swanson is general superintendent.

NEW YORK, N. Y.—Electric power equipment will be installed in the proposed ice-manufacturing and refrigerating plant of the Lion Brewery of New York at Ludlow and Whitlock Avenues, to cost about $400,000. Adolph G. Koenig, 405 Lexington Avenue, is architect.

UTICA, N. Y.—Plans for the proposed addition to the plant of the Munson Mill Machinery Company include a power house. The cost is estimated at $400,000. Charles Kiehm, Gardner Building, is architect.

WATERTOWN, N. Y.—Bids will be received by the Power Corporation of New York, Northern New York Trust Company Building, until April 10 for additional hydro-electric development at the Northern Utilities plant at Effley Falls. The work will include extensions to the present power station to house a 2,000-hp. generating unit, etc. Bids will also be received at the same time for a hydro-electric development at Flat Rock site on the Oswegatchie River, to develop 4,000 hp. W. P. Creager is chief engineer of the company.

YORKSHIRE, N. Y.—The Niagara, Lockport & Ontario Power Company, Buffalo, plans to erect a transmission line to Yorkshire and to install a substation here for light and power service in this district.

BAYONNE, N. J.—The Standard Oil Company of New Jersey, it is reported, will build a power plant at its local oil refinery, to cost about $500,000.

HAMMONTON, N. J.—The installation of a new substation, connecting with the Atlantic County Electric Company by means of a 22,000-volt transmission line and extensions and repairs to its distribution lines are under consideration by the Hammonton Electric Light Company. Charles A. Berry is manager.

NEWARK, N. J.—The Public Service Corporation plans to build a substation at 1223 Broad Street, to cost about $100,000.

ALTOONA, PA.—The Pennsylvania Railroad Company will install electric power equipment in the proposed machine and locomotive repair shop, to be erected at its local yards, to cost about $1,000,000.

ERIE, PA.—The Erie County Electric Company contemplates the extension of its 13,800-volt system for tie-line service and power customers and the erection of a substation at Twelfth Street and Pennsylvania Avenue. Contract has been awarded for the construction of a switch house at Twelfth and French Streets. P. G. Sturtevant is general superintendent.

HARRISBURG, PA.—An electric power plant for emergency service will be installed in the proposed operating building to be erected by the Bell Telephone Company at Pine and Court Streets, to cost about $2,000,000.

MEADVILLE, PA.—The installation of an ornamental lighting system on the main streets, to cost about $25,000, is under consideration.

PHILADELPHIA, PA.—The La France Textile Company, 4423 Frankford Avenue, plans to build a one-story power house.

PHILADELPHIA, PA.—The Philadelphia Electric Company has acquired a site on the Delaware River, near Ontario Street, as a site for a power plant.

PHILADELPHIA, PA.—Electric power equipment will be installed in the proposed addition to be erected by the W. H. McCahan Sugar Refining Company, Tasker Street, to cost about $400,000.

TOWANDA, PA.—The Towanda Gas & Electric Company will install a 375-kva. unit and a switchboard this summer. D. R. Smith is vice-president and superintendent.

WILKES-BARRE, PA. — The Wilkes-Barre & Hazelton Railway Company will build a transmission line to connect with the system of the Pennsylvania Power & Light Company, from which electricity will be secured.

WILLIAMSTOWN, PA.—The East Penn Electric Company has applied for permission to purchase the property of the Lykens Valley Light & Power Company and the Pine Grove Electric Light, Heat & Power Company. Extensions and improvements to the systems are contemplated.

CHARLESTON, W. VA.—The Dewey Furniture Manufacturing Company plans to install a power house in connection with

the rebuilding of its plant, recently damaged by fire, causing a loss of about $100,000.

KEYSER, W. VA.—The Keyser Electric Company contemplates increasing its output either by the installation of a new plant or the purchase of power. E. W. Lothrop is president.

MARTINSBURG, W. VA.—The Potomac Light & Power Company will erect a new 33,000-volt transmission line from Martinsburg to connect with the new steam plant of the Potomac Public Service Company at Williamsport, Md., this spring. W. M. Krise is general superintendent.

PIEDMONT, W. VA.—Renewal of its transmission lines and extending its lines to coal mines for motor service is under consideration by the Piedmont Electric Light & Power Company. Norris Bruce is secretary.

STUART, W. VA.—W. H. Clark, owner of the local electric plant, expects to replace the 50-kw. generator with a 75-kw. to 80-kw. machine, waterwheel type preferred. He may also add another waterwheel.

WASHINGTON, D. C.—Plans are being prepared by Stone & Webster, Inc., 147 Milk Street, Boston, for extensions to the Bennings Road Power Station of the Potomac Electric Power Company, to cost about $1,500,000. The equipment will include 20,000-kw., 60-cycle, 13,200-volt turbine generators, three 1,400-hp. boilers, etc.

WASHINGTON, D. C.—Bids will be received by the Bureau of Supplies and Accounts, Navy Department, until April 24 for 250 storage batteries for use at the Philadelphia and Pensacola (Fla.) navy yards. (Schedule 742.)

North Central States

DETROIT, MICH.—Bonds to the amount of $12,000,000 have been approved by the voters for the construction of a new municipal electric light and power plant and $5,000,000 for street-railway extensions.

SEBEWAING, MICH.—Arrangements are being made for installing new equipment in the municipal electric light plant, for which contract has already been placed. The system will be changed from direct to alternating current. H. J. Davis is superintendent.

CLEVELAND, OHIO. — The Cleveland Electric Illuminating Company is planning to install one additional 25,000-kw., one 30,000-kw. Curtis turbine and four additional boiler units of 3,060 b.hp. each, together with necessary transmission and distribution lines. Robert Lindsay is president and general manager.

MOUNT GILEAD, OHIO. — The Mount Gilead Water, Light, Heat & Power Company will connect with the transmission line of the Morrow Public Service Company and purchase energy for local service. The present steam plant will be held for emergency service. L. C. Dye is secretary.

SABINA, OHIO.—The three-phase high-tension lines of the municipal electric system may be extended and transformers installed for power service. J. C. Phelps is superintendent.

AURORA, ILL. — The Western United Gas & Electric Company has issued $1,323,000 in bonds, part of the proceeds to be used for extensions and improvements.

ALMA, WIS.—New transformer installations and changes in the local light and power distribution system are under consideration by the Wisconsin-Minnesota Light & Power Company.

BUTTERNUT, WIS. — The Butternut Electric Light & Power Company will install an additional engine and generator and will rebuild some lines. W. J. Schulz is president and manager.

LA CROSSE, WIS. — The Wisconsin-Minnesota Light & Power Company has issued $323,750 in capital stock, part of the proceeds to be used for extensions and improvements.

OCONTO, WIS.—The Northeastern Power Company is considering improvements to its Peshtigo water-power station, to cost about $25,000, and also improvements to the local distribution system, to cost about $50,000. Both properties were recently acquired by the company.

PRAIRIE FARM, WIS. — The Prairie Farm Electric Company is planning to change its plant from direct current to alternating current, 2,200 volts, three-phase, 60 cycle. J. A. Helland is president and manager.

RIVER FALLS, WIS.—The installation of a 200-hp. oil engine to operate a 175-kva. alternator in the municipal electric power house is under consideration. F. V. Williams is city clerk.

ELKADER, IOWA.—The People's Electric Service Company contemplates a new hydro-electric development, the erection of about 20 miles of transmission lines and the installation of distribution systems for rural service. W. C. Reimer is secretary and treasurer.

HARTLEY, IOWA.—The Municipal Electric Light Department contemplates erecting a number of rural lines this summer. Fred A. Raasch is superintendent.

OSKALOOSA, IOWA. — Bonds to the amount of $370,000 have been voted for the installation of a municipal electric light plant.

HIGGINSVILLE, MO. — The Board of Water and Light Commissioners is considering buying power from the Kansas City Power & Light Company or purchasing additional equipment for the municipal electric plant during the coming year. O. L. Hebbler is superintendent.

KANSAS CITY, MO. — The American Paper Manufacturing Company contemplates the construction of a power house in connection with a new mill at North Kansas City, to cost about $100,000.

MONETT, MO.—The St. Louis-San Francisco Railroad Company will install electric power equipment in connection with the rebuilding of its local shops, recently destroyed by fire, with loss of $350,000.

ORAN, MO.—Plans are being prepared for a municipal power plant and waterworks, to cost about $40,000. W. A. Fuller, Railway Exchange Building, St. Louis, is engineer.

CROSBY, N. D.—The erection of a high-tension transmission line from Noonan to Crosby is under consideration by the Crosby Light & Power Service. K. S. Huso is manager.

STANLEY, N. D. — The Public Utility Company contemplates erecting a new pole line and distributing system. R. F. Wherland is manager.

ASHTON, NEB. — Extensions to the street-lighting system are under consideration by the Council.

CODY, NEB.—Plans are being prepared for the erection of a transmission line for local service. The municipal lighting plant will be closed down.

FAIRBURY, NEB.—The installation of one 1,500-ft. or 2,000-ft. surface condenser in the municipal electric light plant is under consideration. G. D. Myers is manager.

HARRISON, NEB.—Extensions and improvements are contemplated to the municipal electric light plant, including the installation of a 75-hp. Fairbanks engine and a 60-kva. generator, and changing the system from single-phase to three-phase. T. L. Iversen is superintendent.

ORLEANS, NEB.—The Light and Power Department contemplates extending the municipal transmission lines to Stamford, a distance of 8 miles. N. E. Lideen is manager.

ANTHONY, KAN. — The Anthony Salt Works, Inc., plans to rebuild its power house and mill, recently destroyed by fire, causing a loss of about $250,000.

HUMBOLDT, KAN. — The Humboldt Light & Power Company contemplates the erection of 21 miles of transmission line to take in the towns of Lone Elm, Kincaid and Blue Mound. Work is under way on the construction of a dam and power plant at Neosha Falls, to develop 300 hp. Dwight C. Diver is secretary and treasurer.

INDEPENDENCE, KAN.—Bids will be received by Hugh W. Crawford, city engineer, until May 1 for three motor-driven centrifugal pumps, one of 1,550 gal. per minute and two of 775 gal. per minute, with necessary electric equipment, etc.

WICHITA, KAN.—Plans are under way for the construction of a co-operative power plant, to cost about $150,000. D. S. Jackman, 715 East Thirteenth Street, is interested.

Southern States

ALBEMARLE, N. C.—The Almond Light & Power Company contemplates extensions at its local power plant. Substations will be built at New London and Richfield, and transmission lines will be erected.

CHAPEL HILL, N. C.—The installation of an engine-driven generating unit of 300 kva. or 500 kva. capacity in the university power plant is under consideration. J. S. Bennett is general superintendent.

COOLEEMEE, N. C.—The Cooleemee Ice & Laundry Company plans to construct a power house in connection with a new ice-manufacturing plant.

WALLACE, N. C.—The Tidewater Power Company plans to erect a transmission line to Wallace and a line from Warsaw to Clinton, about 70 miles.

CLINTON, S. C.—The Lydia Cotton Mills contemplates the construction of a power house in connection with a new mill, to cost $750,000.

MACON, GA.—The Massee & Felton Lumber Company contemplates the construction of a power house in connection with the rebuilding of its mill, recently destroyed by fire.

CLEARWATER, FLA.—The Clearwater Lighting Company has arranged for a merger with the St. Petersburg (Fla.) Light Company. Extensions and improvements will be made in the systems.

MIAMI, FLA.—The Tropical Radio Company plans to erect a wireless terminal plant at Hialeah, near Miami, to cost about $250,000, including power plant and equipment.

CHATTANOOGA, TENN.—The directors of the Tennessee Electric Power Company have authorized an expenditure of $1,800,000 for further development of the hydro-electric plant at Great Falls.

CLEVELAND, MISS.—The Home Light & Ice Company contemplates the erection of a transmission line to Boyle to supply electricity to the Boyle Electric Light Company. F. G. Proutt is treasurer.

GLENMORA, LA.—The Glenmora Power Company, Inc., contemplates installing another generating unit this year, consisting of a 100-hp. oil engine and generator. T. L. McNicoll is treasurer and manager.

WELSH, LA. — Improvements are contemplated to the municipal electric plant during this year, including the installation of an 180-hp. engine (Busch Sulzer Brothers) and probably an ice plant of from 10 to 15 tons capacity. John F. Smith is superintendent.

CUSHING, OKLA.—The Illinois Refining Company plans to install electrically operated pumping plants in connection with a 60-mile pipe line to the Tonkawa oilfields, to cost about $200,000.

FORGAN, OKLA.—Plans are being considered for the installation of a 100-hp. Fairbanks-Morse oil engine directly connected to a 60-kw. alternator, also to erect 1 mile of new pole line and about 16,000 ft. of new copper wire. E. E. Crites is superintendent.

SULPHUR, OKLA.—The Oklahoma Light & Power Company has acquired the local power plant. It will be remodeled for a substation. A transmission line will be erected from Pauls Valley.

TULSA, OKLA.—The Prest-O-Lite Company, Indianapolis, Ind., contemplates the construction of a power house at its proposed local plant for acetylene gas production, to cost about $250,000.

TULSA, OKLA.—The Texas Company, New York, contemplates extensions to its power plants in connection with proposed additions to its oil refineries at West Tulsa, Port Arthur and Port Neches, Tex.; Lockport, Ill., and Casper, Wyo. An appropriation of $10,000,000 has been made.

FENTRESS, TEX.—The Fentress Gin Company contemplates changing its electric system from direct to alternating current. J. C. Dauchy is manager.

FORT WORTH, TEX. — The National Lumber & Creosoting Company, Houston, plans to build a power plant in connection with its proposal local wood treatment works, to cost about $100,000.

FORT WORTH, TEX.—Electric power equipment will be installed in the printing plant to be erected on Jones Avenue near Second Street by the World Company, Inc., to cost about $500,000.

MIDLAND, TEX.—The Midland Light & Power Company plans to build an addition to its power plant, to cost about $25,000. Transmission lines will be erected to Odessa and vicinity.

NOCONA, TEX. — The Nocona Ice & Light Company contemplates installing a 150-hp. engine and generator and to erect transmission lines to towns off the line to Terrall and Ringgold. J. W. Lehman is president and manager.

RISING STAR, TEX.—The Rising Star Light & Power Company plans to install additional 80-hp. gas engine directly connected to generator and to extend its service mains. Wright L. Felt is president.

Pacific and Mountain States

LONGVIEW, WASH. — The Long Bell Lumber Company, Kansas City, Mo., contemplates the construction of a power plant in connection with its proposed mills, to cost about $1,500,000.

WASHOUGAL, WASH. — The Western Light & Power Company contemplates the erection of 6 miles of transmission line, using No. 2 bare copper wire. C. W. Cottrell is president.

DAYVILLE, ORE.—Application has been filed at the office of the State Engineer by H. H. and R. B. Cummings to appropriate 15 second-feet of water from the south fork of the John Day River for irrigation and power purposes. The project includes a dam, 4.4 miles of ditch, a Hunt turbine and a 200-kw., 60-cycle alternator. The cost is estimated at $25,000.

EUGENE, ORE.—The installation of an 1,800-hp. generating unit in the municipal electric plant is under consideration. C. A. McClain is secretary and superintendent.

ALHAMBRA, CAL.—E. K. Davis and associates plan to build a hydro-electric plant on Deer Lake.

ARROYO GRANDE, CAL.—Steps have been taken for the installation of an ornamental lighting system.

CORNING, CAL. — The Pacific Gas & Electric Company will make extensions and improvements to its local system, including the installation of new lamp standards, to cost about $53,600.

FRESNO, CAL.—Bids will soon be asked for the instaliation of an ornamental lighting system, consisting of ninety-nine single-lamp standards, to cost about $25,000.

FRESNO, CAL.—The San Joaquin Light & Power Corporation will build a mechanical plant at Orange and California Streets, including a meter-testing and repair shop, transformer-testing station, transformer warehouse, pole-treating plant, cross-arm mill and machine shop, to cost about $300,000.

LOS ANGELES, CAL. — The Southern California Edison Company contemplates an expenditure of $26,000,000 for extensions and improvements during the present year as follows: $11,851,000 for hydro-electric power development, $4,149,000 for substations and transmission lines, $265,000 for steam and water-power plants, $6,800,000 for distributing lines and stations, $1,400,000 for miscellaneous equipment, and $1,535,000 for low-voltage transmission lines.

SAN FRANCISCO, CAL.—F. B. Cross, care of Rudolph W. Van Norden, Mills Building, engineer, has been granted permission to construct a hydro-electric plant on Deer Creek, Tehama County, to develop 18,600 hp., to cost about $1,700,000.

SAN FRANCISCO, CAL. — The Utica Mining Company, 575 Mills Building, plans to install a hydro-electric plant on Highland Creek, Tuolumne County, to develop 3,300 hp., at a cost of about $150,000.

ST. GEORGE, UTAH.—The Dixie Power Company has applied to the State Engineer for permission to divert 30 cu.ft. of water from the Santa Clara River in Washington County for power purposes. The plans call for a development of 800 hp. and will include a channel 30,450 ft. to divert the water and a 5-ft. Pelton waterwheel.

LIBBY, MONT.—The Libby Water & Electric Company contemplates building a dam, 50 ft. high and also the installation of a second-hand 250-kw., three-phase, 2,300-volt generator and Pelton waterwheel and may possibly purchase about 2,000 ft. of 24-in. conduit or pipe to carry 250 ft. static head. Judson Bibb is manager.

STOCKTON, CAL.—The Western Gas & Electric Company is building a new hydro-electric plant on the South Fork of the American River, to have an ultimate capacity of 100,000 hp. The initial unit of 27,000 hp. will be completed by the latter part of this year. B. F. Wellington, Jr., is secretary and treasurer.

WORLAND, WYO.—The Big Horn Light & Power Company contemplates installing two 100-kw. generators, directly connected to generators, and the erection of transmission lines from the hydro-electric plant to Worland; also to install two 50-kw. natural-gas units this summer. M. W. Thompson is secretary and manager.

KEMMERER, WYO.—The Frontier Supply Company contemplates the installation of a 2,000 kw. Curtis turbo-generator unit. P. J. Quealy is president and manager.

SANTA FE, N. M.—The Santa Fé Water & Light Company is installing a 500-kw. Curtis steam turbine. A. J. Griffin is manager.

Canada

EDMONTON, ALTA. — The Department of Railways and Telephone contemplates 1,500 miles in telephone extensions, to cost about $800,000.

BARRIE, ONT. — The installation of about 6,000 ft. of underground work is under consideration by the municipal electric light department. J. A. Hare is superintendent.

CAMPBELLFORD, ONT. — The Hydro-Electric Power Commission of Ontario contemplates a 10,000-hp. development at Dam 8 on Trent River, near here, to cost about $1,066,000. F. A. Gaby is the chief engineer.

FORD, ONT.—The Town Council is considering an issue of $26,000 in debentures for extensions to the local Hydro-Electric system.

PARIS, ONT.—The Hydro-Electric and Water Commission contemplates increasing the transformer capacity of substation. Fred Bishop is secretary and treasurer.

TORONTO, ONT. — The Hydro-Electric Power Commission of Ontario is planning to erect a 100-mile steel-tower transmission line from Niagara Falls to St. Thomas to cost about $1,000,000. F. A. Gaby is chief engineer.

TORONTO, ONT.—Extensions and improvements to lighting and power systems, to cost about $2,000,000, are under consideration by the Toronto Hydro-Electric System, to include transformers, wire, cables, concrete poles, etc.

WALKERVILLE, ONT.—The City Council has granted the petition of the local Hydro-Electric Commission for an appropriation of $50,000 for extensions to the Hydro-Electric system this year.

YORKTON, SASK. — Extensions to the municipal electric system, to cost about $100,000 are under consideration.

Electrical Patents

Announced by U. S. Patent Office

(Issued March 20, 1923)

1,449,167. DISCHARGE TUBE FOR ELECTRICAL APPARATUS; G. Collins, Chicago, Ill. App. filed Sept. 30, 1920. For medical applications.

1,449,201. ELECTRIC FLATIRON; A. H. Smith, New York, N. Y. App. filed April 14, 1921. Control switch operated by handle.

1,449,202. STREET-CAR BARN; W. F. Snohr, Chicago, Ill. App. filed Feb. 10, 1922. Providing means for quickly moving cars in case of fire.

1,449,206. METHOD OF AND APPARATUS FOR HEAVY SPOT WELDING; J. M. Weed, Schenectady, N. Y. App. filed Nov. 29, 1920. For spot welding heavy plates and structural parts.

1,449,239. CONTROLLER FOR ELECTRIC MOTORS; N. L. Mortensen, Milwaukee, Wis. App. filed May 31, 1921. Controller adapted for series-parallel commutation of plurality of motors.

1,449,248. COMINATION LOCKING MECHANISM; G. D. Rathbun, Kansas City, Mo. App. filed Sept. 14, 1921. Electromagnetic combination locking mechanism for doors.

1,449,249. RHEOSTAT; J. T. Rhamstine, Detroit, Mich. App. filed Aug. 8, 1922. Filament rheostat for radio sets.

1,449,251. ELECTRIC FURNACE REGULATOR; J. A. Seede, Schenectady, N. Y. App. filed Feb. 4, 1920. Automatic control of electrodes.

1,449,253. UNIDIRECTIONAL RECEIVING SYSTEM; M. S. Strock, Washington, D. C. App. filed Sept. 23, 1921. Circuit employs two tubes.

1,449,278. ELECTRIC IRON; A. Fleming, Alexandria, Va. App. filed Feb. 10, 1921. Automatically controls current.

1,449,305. APPARATUS FOR TEACHING TELEGRAPHY; E. H. Snyder, Baltimore, Md. App. filed July 15, 1921.

1,449,307. ELECTRIC FURNACE; L. Tagliaferri, Genoa, Italy. App. filed March 25, 1920. Arrangement of electrodes for supplying and distributing current.

1,449,319. PROCESS OF MELTING AND DEOXIDIZING STEEL; A. E. Greene, Seattle, Wash. App. filed May 3, 1916. Treating with special slag in electric furnace.

1,449,357. FILTER INDICATOR FOR X-RAY SYSTEMS; H. F. Waite, New York, N. Y. App. filed Sept. 28, 1921. Indicates whether undesired waves are passing through screen.

(Issued March 27, 1923)

1,449,370. CURRENT-CONTROLLING DEVICE; V. G. Apple, Dayton, Ohio. App. filed Jan. 17, 1919. Combined starting switch, automatic current regulator and overload and underload cut-out for automobile generators.

1,449,371. METHOD OF CONSTRUCTING ARMATURES FOR DYNAMO-ELECTRIC MACHINES; V. G. Apple, Dayton, Ohio. App. filed Sept. 15, 1919. Windings of armature inclosed in refractory insulating armor.

1,449,372. SYSTEM OF TELEPHONY; H. D. Arnold, East Orange, N. J. App. filed Dec. 1, 1915. Wireless signaling by means of modulated high-frequency waves or currents.

1,449,382. METHOD AND MEANS FOR SIGNALING WITH HIGH-FREQUENCY WAVES; J. R. Carson, New York, N. Y. App. filed Dec. 1, 1915. Similar to Squier high-frequency telephone system.

1,449,391. COMBINATION FLASHLIGHT AND TOILET ARTICLE; L. Franklin, New York, N. Y. App. filed March 9, 1922. Electrically lighted vanity case.

1,449,406. ELECTRIC HEATER; M. E. Householder, Pittsburgh, Pa. App. filed Oct. 29, 1921. Resistance-wire water heater.

1,449,425. HEATING SYSTEM FOR TYPESETTING MACHINE CRUCIBLES AND THE LIKE; E. N. Lightfoot, New York, N. Y. App. filed Oct. 10, 1916. Automatically governs electric heaters for linotype pots.

1,449,437. FLOW METER; J. A. Obermaier, Chicago, Ill. App. filed Jan. 2, 1918. Totalizing meter operated by pilot tubes in pipes and variable resistance.

1,449,460. CLAMP FOR BINDING SCREWS AND THE LIKE; B. G. Thomas, Bridgeport, Conn. App. filed Dec. 20, 1918. For lamp sockets, switches, cut-outs, etc.

1,449,462. METHOD AND APPARATUS FOR THE ELECTROLYTIC RECOVERY OF COPPER; G. D. Van Arsdale, New York, N. Y. App. filed Sept. 24, 1920. Precipitation of copper from mine waters.

1,449,487. TELEPHONE SYSTEM; E. M. Ashworth, Toronto, Ontario, Can. App. filed April 7, 1920. Automatic-exchange.

1,449,500. CONTROLLING MECHANISM FOR ELECTRIC MOTORS; W. Davis, Chicago, Ill. App. filed June 12, 1922. Speed governor for automobile motors.

1,449,501. TELEGRAPH INSTRUMENT; O. R. Dorris, Harney, Minn. App. filed Aug. 1, 1921. Telegraph sounder operated directly by current from main circuit.

1,449,511. TELEPHONE SYSTEM; H. H. Ide, La Grange, Ill. App. filed Feb. 14, 1919. Two-wire type where directively controlled switches are operated by subscribers' circuits.

1,449,517. HEATING IRON FOR MELTING PLASTIC SUBSTANCES; H. F. Lame, Jersey City, N. J. App. filed March 28, 1922. Wax, glue, etc., electrically heated and melted in tube from which it is applied to object.

1,449,539. DYNAMO-ELECTRIC MACHINE; A. H. Neuland, Jersey City, N. J. App. filed Aug. 21, 1920. Electric transmission for automobiles.

1,449,557. RHEOSTAT; L. A. Seiss, Toledo, Ohio. App. filed May 6, 1922. Vacuum-tube-filament rheostat.

1,449,573. CONTROLLING SYSTEM; W. P. Albert, Newark, N. J. App. filed May 1, 1920. Control of step-by-step telephone equipment.

1,449,577. DYNAMO-ELECTRIC MACHINE; C. O. Bergstrom and P. de Clamecy, Boston, Mass. App. filed Aug. 18, 1919. Construction of fractional-horsepower motors that reduces their weight.

1,449,578. FURNACE REGULATOR SYSTEM; C. A. Boddie, Pittsburgh, Pa. App. filed June 25, 1919. Control of electrodes.

1,449,579. FURNACE REGULATOR SYSTEM; C. A. Boddie, Pittsburgh, Pa. App. filed Nov. 6, 1919. For governing movable electrodes of electric furnaces.

1,449,593. FURNACE REGULATOR SYSTEM; R. D. Evans, Wilkinsburg, Pa. App. filed Oct. 30, 1918. Movable electrodes automatically raised and lowered.

1,449,627. ELECTRIC INCANDESCENT LAMP; E. Rohner, Rheineck, Switzerland. App. filed Dec. 14, 1921. Two-filament lamp.

1,449,632. ELECTRIC WAVING IRON; E. R. Talbot, Chicago, Ill. App. filed March 6, 1922.

1,449,644. TELEPHONE SYSTEM; C. White, East Orange, N. J. App. filed Dec. 30, 1919. Signaling circuit wherein simplexed physical lines are utilized.

1,449,658. ELECTRIC LAMP FIXTURE; M. F. Deach, Oakland, Cal. App. filed Oct. 27, 1920. Extension-arm lamp.

1,449,694. PROTECTIVE DEVICE; F. W. Peek, Jr., Pittsfield, Mass. App. filed Sept. 18, 1919. Resistance between transmission line and insulator for protection against surges.

1,449,722. HIGH-FREQUENCY SIGNALING SYSTEM; W. R. G. Baker, Schenectady, N. Y. App. filed Sept. 17, 1921.

1,449,725. ELECTRICAL APPARATUS; F. R. Beckert, Schenectady, N. Y. App. filed Oct. 18, 1921. Potentiometer for electron tubes.

1,449,746. ELECTRIC BATTERY OR ACCUMULATOR; W. H. Exley, Woking, and G. H. Handasyde, West Byfleet, England. App. filed Jan. 6, 1923. Arrangement of electrodes in minimum space.